ENTOMOLOGICAL REVIEW

A translation of Entomologicheskoe Obozrenie

(Russian Original Dated July-September, 1960)

Volume 39, No. 3, pp. 359-542 January-March, 1961

CONTENTS

	PAGE	RUSS. PAGE
Fundamentals in the Methods Employed for the Preservation of Grain Crops in the Cultivated Zones of Virgin and Long-Fallow Lands. T. G. Grigor'eva.	359	509
On the Evolution of the Leg in Tracheata. Part I. The Subcoxal Theory and Its Criticism. E. G. Bekker.	368	521
Gall-Lice (Homoptera, Phylloxeridae) in Artificial Plantations in the Ukraine. G. V. Dmitriev.	374	529
Weevils (Coleoptera, Curculionidae) as Timber Pests in Houses and Structural Timberwork. V. Ya. Parfent'ev.	385	545
On Fruit-Moths (Microlepidoptera) and Their Parasites in the Maritime Territory. L. S. Sytenko	389	551
Gonotrophic Cycle in Phytophagous Species of Black Flies (Diptera, Simulidae). I. A. Rubtsov.	392	556
Study of House Fly (Diptera, Muscidae) Migrations in Chita by Means of Luminescent Tagging. A. M. Zaidenov.	406	574
Biology of Fruit Flies of the Genus Dicraeus (Diptera, Chloropidae). E. P. Narchuk.	415	585
On the Flight of Beetles to the Light of Mercury-Quartz Lamps. P. D. Zhantiev and V. B. Chernyshev.	421	594
The Effect of Ionizing Radiation Upon the Development of Pectinophora Malvella Hb. V. V. Vasilyan.	425	599
Biology of Phylloxera and Methods for Its Control. Ya. I. Prints.	429	605
Acrididae (Orthoptera) of Sinkiang. E. P. Tsyplenkov.	432	610
True Bugs (Heteroptera) of the Eastern Sector of Arctic Eurasia. A. N. Kirichenko.	438	617
Data on the Fauna and Ecology of Leaf-Beetles (Coleoptera, Chrysomelidae) of the Southern Rear Bank of the Dnieper River. I. K. Lopatin.	447	629
On the Fauna and Phenology of Gad-Flies (Diptera, Tabanidae) in the Nakhichevan ASSR. E. G. Hauser.	458	643
The Syrphid Fauna (Diptera, Syrphidae) of Transcaucasia. L. V. Zimina.	472	661
Three New Species of Plecoptera from the Altai and Sayan Mountains. Yu. I. Zapekina-Dul'keit.	476	666
East-Asiatic Species of Weevils (Coleoptera, Curculionidae) in the Fauna of the USSR. M. E. Ter-Minasyan.	481	671
On the Taxonomy and Distribution of Bark Beetles (Coleoptera, Ipidae) in the USSR and Adjacent Countries. B. V. Sokanovskii.	483	674
New and Little-Known Asiatic Psychidae (Lepidoptera). I. V. Kozhanchikov	486	679
Phiaris Captiosana, SP. N. – A Vicariate of Phiaris Arcuella Cl. in the Eastern Regions of the Palaearctic. M. I. Fal'kovich.	494	690
Some Butterflies (Lepidoptera, Rhopalocera) of the Palaearctic Fauna. A. E. Standel.	497	693
A Palaearctic Species of the Genus Coelopencyrtus Timb. (Hymenoptera, Encyrtidae) V. A. Tryapitsyn.	500	697

CONTENTS (continued)

	PAGE	RUSS. PAGE
Species of Genus Coccophagus Westw. (Hymenoptera, Chalcidoidea) from Szechwan Province, China. E. S. Sugonyaev and P'eng Chung-yun.	503	701
Representatives of the Genus Praon (Hymenoptera, Aphidiidae) in Hungary. J. Györfi.	508	708
Flies of the Genus Conophorus Meig. (Diptera, Bombyliidae) in the Transcaucasian Fauna. V. F. Zaitsev.	511	713
A Brief Survey of Parasitic Diptera Belonging to the Subtribe Ernestiina in the Palearctic Fauna (Diptera, Larvaevoridae). II. L. S. Zimin.	520	725

FUNDAMENTALS IN THE METHODS EMPLOYED FOR THE PRESERVATION OF GRAIN CROPS IN THE CULTIVATED ZONES OF VIRGIN AND LONG-FALLOW LANDS

T. G. Grigor'eva

All-Union Institute for Plant Protection VASKhNIL, Leningrad
Translated from Entomologicheskoe Obozrenie, Vol. 39, No. 3, pp. 509-520, July-September, 1960

In the very short period of two to three years the natural covering of vegetation on the steppes of the huge territory in northern Kazakhstan and southern Siberia was replaced by crops of summer wheat.

There, at the present time, the areas sown with crops comprise 41.2% of all the cropped areas in USSR. Out of the 66.7 million hectares of wheat sown in the whole of USSR, 43.5 million hectares, or 65.3%, were allocated to the virgin areas. The total yield of grain in the principal districts of the newly cultivated land amounted to 58.4 million tons in 1958, or 42% of the grain yield of the whole country (Anismov, 1959).

In fact, these regions represent a huge factory for the production of a most valuable grain – wheat.

The figures given above show that the protection of the grain harvest on these virgin lands from the losses caused by insect pests present a problem of great national importance. These losses may be extremely large. In 1957, the deficit in the grain harvest in Kazakhstan, and Siberia resulting from the mass reproduction of the gray grain moth [Hadena sordida Bkh. (=anceps Hübn.)] exceeded 150 million poods. This quantity of grain would be sufficient to feed the population of eight to ten large industrial towns for a year.

In the solution of the practical problems concerning the protection of the grain harvest in the new agricultural areas one should take into account the zonal conditions which call for a certain specificity in the development of the forecasting of outbreaks of destructive insects and in the building up of a system of prophylaxis and measures for extermination.

The chief feature of these new areas is the narrow specialization in farming – the cultivation of summer wheat as a single crop.

It is essential to point out here that the production of grain is accomplished in the absence of a settled system of farming. In virtue of this, farm management methods, in accordance with the undertakings decided on by the December meeting of the Central Committee of the Communist Party of the Soviet Union, will undergo a particularly large change in the course of the current seven-year period. Naturally, the problems connected with plant protection were provided for during the reforms.

The second feature in these new areas is embodied in the extreme dynamic forces present in the ecological conditions. The plowing of the feathergrass steppe led to a complete reorganization of living conditions for those animals indigenous to the virgin soils and caused a radical change in number and species-composition of the fauna during the process of its specialization within the biocoenosis of the wheat field.

In the many works of Bei-Bienko (1936, 1939, 1954, 1957, 1959), and also in the works of Gilyarov (1945, 1955), Grigor'eva (1951, 1955), Tanskii (1959) and others, great stress is laid on a knowledge of the general principles governing the processes of the formation of the faunas in the agrobiocoenoses of wheat crops newly created by man in the utilization of virgin areas on the feathergrass steppe.

Similar principles governing the faunal changes during the cultivation of peat and stagnant soils for agricultural crops or in the changes of land utilization connected with forest plantings are discussed in the numerous writings of applied entomologists, ecologists and faunists (Arnol'di, 1952, 1953; Aleinikova, 1953; Berezina, 1937, 1952; Kipenvarlits, 1953; Stark, 1949, 1959, and many others). In our century of grandiose schemes for transforming nature they represent a valuable contribution to the solution of the practical problems of plant protection.

In the plowing of the virgin steppe the formation of the primary nucleus of the wheat field fauna proceeds very swiftly and, according to Bei-Bienko (1957), is completed within the first year of sowing. The great majority of species indigenous to virgin soils are not preserved in the wheat biocoenosis. Populations of specialized pests are formed here both at the expense of migrants from old wheat fields and of the sparse populations from the virgin steppe.

Investigations into the discovery of the principles concerned in the formation and dynamics of the fauna

on wheat stands after the plowing of the steppe are under the supervision of the All-Union Institute for Plant Protection from 1954 at a fixed point in the Karabalyk district of the Kustanay region with a simultaneous inspection of the neighboring districts of Kazakhstan and RSFSR.

These investigations showed that the sudden increases in numbers of many of the destructive, oligophagous insects in the wheat field biocoenosis, in comparison with the original biocoenoses of the feathergrass virgin lands and the old long-fallow lands with Festuca sulcata, were brought about chiefly by two factors: firstly, by a considerable development of the feeding phase on the crops and of the numbers of individuals present and, secondly, by a considerable diminution in the density of parasites and predators.

Figures concerning the fertility of insects may serve as an illustration of the feeding advantages which are available to the destructive, oligophagous insects in wheat fields in comparison with the natural associations on grass.

The female of the bug Aelia siberica Reut., reared on the young growth and ears of wheat, laid $1\frac{1}{2}$-2 times as many eggs as the female reared on the green parts and ears of wild grasses. Similar comparisons can be cited for the gray grain moth. The survival of the young caterpillars developing in the wheat ear is more than $1\frac{1}{2}$ times that of caterpillars feeding on the ears of couch grass. The loss of caterpillars during the period between hatching and the 3rd-4th instars amounted to about 60% in the first instance and to more than 80% in the second instance.

The data in Fig. 1 illustrate the quantitative and qualitative changes of the insect fauna in the wheat field biocoenosis after plowing the feathergrass virgin soils and long-fallow grass land.

By periodical estimates of the numbers of insects on old long-fallow lands with a predominance of feather and Festuca sulcata grasses and on wheat crops following the plowing of these lands it was possible to obtain such data as the following: – the numbers of specialized pests on the wheat stands sharply increased in comparison with those on long-fallow lands: leaf pests (Phyllotreta vittula Redt.) 30-50 times, ear and grain pests (Haplothrips tritici Kurd., Hadena sordida Bkh., Aelia sibirica Reut. and other cereal bugs) 10-32 times, internal stem pests (Chaetocnema aridula Gyll., Ch. hortensis Geoffr. Oscinella pusilla Meig.) 1.3-15 times. At the same time the numbers of polyphagous pests, in which the development of the eggs or larvae is connected with the soil, decreased: – locusts 4-22 times, tenebrionids $3\frac{1}{2}$-5 times, elaterid larvae 1.7-5 times. Naturally, there is a drop in the numbers of predators and parasitic insects: – ground beetles 4-19 times, ants (predatory and omnivorous) 5-14 times, parasitic hymenoptera 2 times. Certain species of specialized predators, for example, Adonia variegata Goeze., are characterized by their somewhat greater numbers on wheat in comparison with those on long-fallow lands bearing Festuca sulcata grass, but this did not make up for the decrease in the groups of parasites and predators as a whole. The change in the numbers of the given insect groups is more marked on wheat crops grown on plowed Festuca, long-fallow land; less marked on feathergrass, long-fallow land. According to the observations of Tanskii (1959) in the same district the relative abundance of arthropods preying on wheat thrips is 30 times less in the wheat biocoenosis than in the biocoenosis on virgin soils.

On wheat stands established on old arable soils the activity of parasites and predators is once more somewhat accelerated; in relation to the whole population the number grows 2-5 times (Table 1). Thus, the

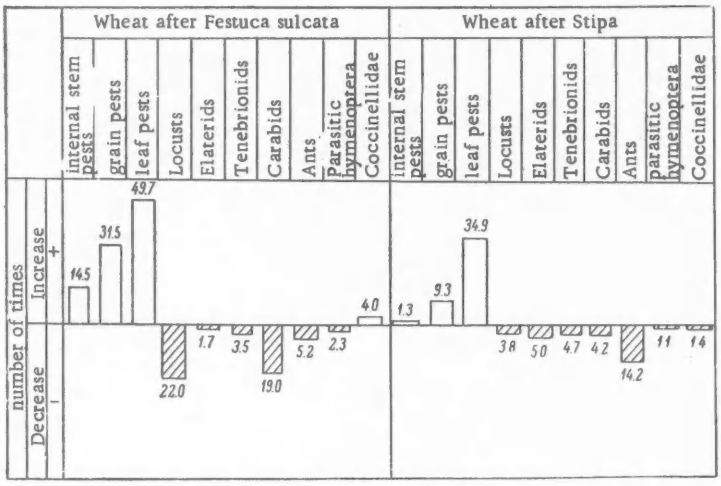


Fig. 1. The change in numerical composition of groups and species of insect on wheat fields after plowing long-fallow lands.

TABLE 1 Comparative Numbers of Certain Groups and Species of Insects in Wheat Fields on Old Arable Lands and on Crops During the First Year Following the Plowing of Virgin Soils and Long-Fallow Grassland (Karabalyk district, Kustanay region, 1954)

Forerunner of wheat	Number of Groups and Species of Insect									Parasites and Predators (%) in relation to whole population.
	Swedish fly	Mero-myzid flies	Internal stem pests	Striped cereal beetle	Cereal bug	Thrips	The variable lady-bird	Parasitic hyme-noptera	Ants	
Wheat on old arable land	34	24	8	45	64	372	16	67	3	13.2
Virgin land with feathergrass	11	17	8	69	24	773	8	40	218	23.0
Long-fallow land with Festuca sulcata grass.	14	25	5	497	33	785	4	47	86	6.4
Long-fallow land with couch grass	60	60	33	943	54	1357	13	46	11	3.7

colonization of wheat fields by parasites and predators proceeds slowly and falls behind their colonization by destructive, oligophagous insects.

This lag in the establishment of the parasite and predator complex behind that of the phytophagous fauna, the direct consumers of agricultural plants, evidently represents the general rule which appears in all instances where crops cultivated in a given district are new.

Chao Tsien-ming (1959) observed a similar phenomenon in new districts in which maize cultivation was introduced.

A repercussion of this same phenomenon was seen in the very large differences in the infestation by parasites of the larvae of the gray grain moth when populations from old and new agricultural districts of Siberia and northern Kazakhstan were compared. In districts or on farms where the land had been worked for a long time the larvae infested by ichneumon and tachina flies amounted to 60-80%; in similar districts, recently cultivated, the numbers did not exceed 1-7%, with a maximum of 13%. Besides the length of time during which the land had been worked, the agricultural landscape has a large influence on the role of parasites, especially the presence of birch cuttings and forest stands with flowering plants along the fringes and also in river valleys.

Table 2 serves to illustrate these points and is compiled on the basis of dissections of caterpillars of Hadena sordida Bkh. from collections made in the autumn of 1958 and 1959 from more than 100 farms situated in 13 regional zones of distribution of the gray grain moth. The same relationship is seen in infestations by the adult stage of Aelia siberica Reut., collected under natural conditions on various farms in the Karabalyak district.

Simultaneous with the swiftly advancing processes in the establishment of the initial nucleus of the wheat field fauna from widely distributed pests, another slower process is observed, namely, the adaptation of oligophagous insects, arising from the virgin land fauna, to life on agricultural crops. For example, among the bugs of the genus Aelia, represented in the region of northern Kazakhstan principally by A. siberica Reut and A. acuminata L., one is able to follow the initial steps in this process: the first species actively adjusts itself to development on wheat and populates the wheat fields almost exclusively; A. acuminata is gradually supplanted by the Siberian bug, changing from a dominant into an attendant species few in numbers.

An illustration of this is seen in Table 3 which is drawn up on the basis of collections of the bug Aelia from wheat fields and grass pasture in the Karabalyk district of Kustanay by the author in the year 1954 and by E. S. Terekhin in 1958.

At the present time it is hardly possible to visualize, from the composition of the "wild" fauna of the steppe, all the potential pests which might threaten the harvest as well as to forecast the rate at which they would become adapted to living in wheat fields.

In this connection, A. siberica does not seem to be a unique example. In recent years the wheat, or yellow, sawfly Pachynematus clitellatus Lep. has begun to appear in a similar manner but only locally (principally within the boundaries of the Akmolinsk region). With regard to this species Kurdymov (1912) has noticed its close connection with couch grass.

In the utilization of estuarine districts in Zavolzh'e for agricultural crops, instances were described by Antonova (1958) of pests among the "wild," oligophagous insects, connected in their development with the pasture of estuarine meadows, colonizing these areas after their

TABLE 2 Influence of the Landscape and the Antiquity of the Utilization of Land Under Wheat Crops on the Activity of Parasites of the Cereal Moth and the Bug Aelia

Region	District	Character of the district	Character of the farms	Percentage infection of insects by parasites	
				1958	1959
		Larvae of Hadena sordida Bkh.			
Kustanay	Karabalyk	Wooded steppe of ancient cultivation	Old arable land with strips of forest	77.6	—
Kokchetav	Ruzaev	Steppe	Old arable land, valley of the river Ishim	70.6	—
Chelyabinsk	Poltava	Wooded steppe	Old arable land	52.0	81.2
Orenberg	New Orsk	Steppe	Ditto	—	52.0
Omsk	River Polyan	Wooded steppe	Ditto	48.3	—
Akmolinsk	Akmolinsk	Steppe of ancient cultivation	Old arable land	—	48.9
	Esil'	Virgin soil	New land	13.7	—
Karaganda	Osakarov and Tel'manovo	Steppe of ancient cultivation	Old arable land with strips of forest	—	48.8
	Nurin	Virgin soil	Old land	—	18.6
		Steppe	New land	—	7.1
Pavlodar	Pavlodar and little Tel'manovo	Steppe	Ditto	—	1.0
	Urlutyup Lazov and Ermakov	Virgin soil	Valley of the river Irtysha	—	34.2
		The bug Aelia			
Kustanay	Karabalyk	Wooded steppe	Old arable land with strips of forest	—	30.1
		Steppe	New land	—	7.0

cultivation with cereal crops and grass. Among a number of these species recorded by him were a few belonging to the genera Harmolita and Cephus and also representatives of the families Buprestidae and Mordellidae not recorded earlier as agricultural pests.

Populations of specialized pests which have colonized wheat fields in recent times in regions where virgin land is being utilized are a long way from being identical with populations of the same species in other climatic and productive districts. Adaptation to development in plant associations found on the uncultivated steppe is evident among the specialized pests feeding on wild grasses and having permanent trophic relations with them, and also in the dates relating to their own development which appear to be adjusted to the phenology of wild grasses much more so than to the phenology of agricultural field crops. These phenomena are of great interest in the theory and practice of plant protection. At the present time they are manifest to a greater or lesser degree in all specialized pests of grain crops growing on virgin and long-fallow lands and can be illustrated by examples.

In the Akmolinsk region the Hessian fly, a pest of wheat in the European parts of USSR, develops chiefly in pasture land on grasses closely related to the wild Agropyron. According to the observations of A. I. Karpov, the number of larvae in the summer generations of flies amounted to an average of 2.6 individuals per sq. m. on wheat fields, but on fields of couch grass (non-rhizome) it reached 115 individuals per sq. m., that is, 45 times as many.

The gray grain moth lays the greater number of its eggs in the ears of creeping couch grass. A strict synchronism was observed between the dates of oviposi-

TABLE 3. Comparative Colonization of Wheat Stands and Pasture Grass by the Bug Aelia (According to Observations in the Karabalyk District, Kustanay Region; Given as Percentages of the Number of A. siberica on Wheat in 1954)

	Crop				
	Wheat fields		Pasture grass		
	A. sibirica	A. acuminata	A. sibirica	A. acuminata	A. klugi
1954	100.0	—	41.9	206.4	3.2
1958	258.0	12.9	300.0	54.8	16.1

TABLE 4. Hydrothermal Coefficient for April, May and June in the Karabalyk District

1956	1957	1958	1959	Average for several years
1.07	0.10	0.59	0.95	0.96

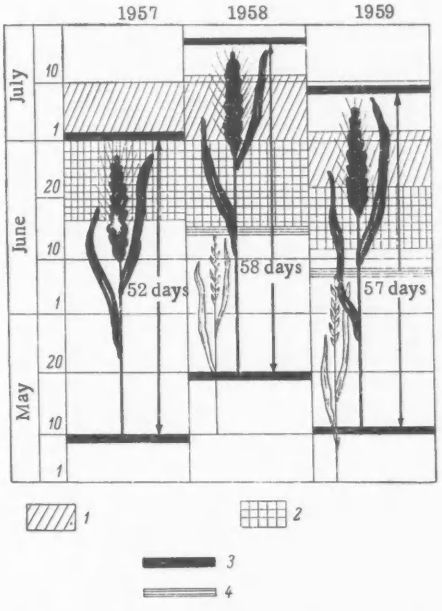


Fig. 2. Times of oviposition (1) and flight (2) of and the moth Hadena sordida Bkh. compared with the times of sowing and earing of wheat (3) and with times of earing in wild couch grass (4). (Karabalyk district, Kustanay region).

tion and the dates of ear formation in Agropyron repens under natural conditions.

Egg-laying by the moth in wheat ears, in years in which ordinary weather conditions prevail, takes place in the field at the earliest dates of ear formation, approximating those for wild grasses. During these years the period of mass oviposition sets in and is completed by the time ear formation has taken place in wheat fields of average sowing dates and all the more so in fields sown later. However, a dry spring, similar to that of 1957 which accelerated ear formation in plants suffering from a deficiency of moisture, led to the mass infestation of fields by eggs of the gray grain moth and produced all the prerequisites for the mass increase of the moth.

Fig. 2 serves as an illustration of these observations. It shows the flight and oviposition periods of the moth compared with the sowing times and times of ear formation of wheat and also with the times of ear formation in wild couch grass Agropyron repens in the period from 1957 to 1959 in the Karabalyk region. Table 4 shows the hydrothermal coefficient $\frac{\epsilon \text{ precipitation} \cdot 10}{\epsilon t^{\circ}}$ for the three spring months (April, May, June) for the same district. The conformity or nonconformity in the dates of ear formation in wheat and of mass oviposition of the moth depends to a very large degree on weather conditions in spring. In 1957, the year of the mass spread of the grain moth, the hydrothermal coefficient was at a minimum, almost 10 times smaller than the average coefficient for several years.

The given relationships reveal to a considerable degree the causes of mass increase of the gray grain moth and also the reasons for the greater or lesser loss of harvest brought about by the ravages of the caterpillars. Drought years lead, not only to an intensive infestation of the wheat ears by the eggs, but to an earlier harvest which coincides with an earlier instar.

Indeed, in 1957 at harvest time the caterpillars were predominantly of the 7th instar, but in 1958 and 1959 the predominant instars were the 5th and a partial 6th.

The caterpillars begin to do appreciable damage when they reach the 5th instar and eat, on an average, about 16mg grain per day. The voracity of the following instars increases in such proportions as 1 : 1.8 : 2.3 : 3.1.

On the other hand, from the given data one is obliged to assume that the gray grain moth, as a pest is weakly adapted to the growing of summer wheat and at the present time is very vulnerable to the effects of agrotechnical practices.

It might be considered that the protracted autumnal feeding of the grain moth caterpillar, necessary for its transformation into the subsequent overwintering instar, is a form of adaptation to development on crops growing on virgin soils. This adaptation is easily realized in plant associations on the steppe but is not so easily

TABLE 5 Comparative Colonization of Wheat Plants, Sown on Different Dates, by Larvae of Internal Stem Pests and by Wheat Thrips

Kurgan region; data from Bobinskaya, 1959

Name of Insect	Date of Sowing Wheat					
	Sown 30th April		Sown 12th-15th May		Sown 25th-26th May	
	% damaged stems	Number per sq. m.	% damaged stems	Number per. sq. m.	% damaged stems	Number per. sq. m.
Hessian fly	1.4	3	5.6	20	0.0	0
Meromyzid flies	12.3	21	0.9	4	0.3	2
Stem flea beetles	28.1	44	35.1	69	41.0	14

Kustanay region, Karabalyk district; data from Tanskii, 1959

Item	Date of Sowing Wheat		
	12th May	18th May	24th May
Number of species investigated	10	10	8
Number of wheat thrips larvae per 100 grains	155	135	102

secured on wheat stands where seasonable dates apply to the harvesting of grain and to the autumnal cultivation of the soil. The adaptation of this species to development on wheat stands proceeds, evidently, in the direction of selection of individuals possessing the capacity of emerging from the pupa much later in the spring and of laying eggs on wheat which is in the stage of ear formation. This can reduce the insect from the category of a pest capable of sudden fluctuations in numbers to that of a permanent pest in regions where virgin and long-fallow lands are cultivated.

The same zonal peculiarity, namely, the adaptation of the life cycle to the phenology of wild grasses, is characteristic of other destructive oligophagous insects. It is seen in a more intensive colonization by stem flea beetles, by the Hessian fly and wheat thrips from earlier crops. This is shown by the work of Bobinskaya (1959) and Tanskii (1959) (Table 5).

From his own investigations Yatskaya (1959) came to a similar conclusion with regard to the stem chrysomelid Ch. hortensis in the Kurgan region.

Evidently, the adaptation of the wheat thrips larva to hibernation bears a zonal character; under the conditions of northern Kazakhstan it occurs chiefly in the soil but in the European parts of USSR it takes place in the roots of grasses.

Zonal characteristics of the new agricultural districts are bound up not only with the recent utilization of the feathergrass steppe but with climatic conditions of a decided continental character which distinguish it from districts in the European lowlands. If the first of these features makes itself felt by preserving harmful insect species having close trophic ties with the wild flora, so the second feature alters the conditions of insect hibernation in arable land and adapts insects to the endurance of winter cold.

The data which have been quoted show that the entomological aim in having very early dates for sowing wheat in order to secure protection from insect attack in the old farming districts of the country is, to a considerable degree, lost.

The importance, in the entomological sense, of deep, winter plowing, together with the turning of the soil which was considered (Gilyarov, 1955; Shchegolev, 1955) as a dependable measure for the control of a whole series of destructive pests hibernating in arable land proves to be, under the conditions of the zones in question, considerably less than, for example, the superficial working of the soil proposed by Mal'tsev. As the researches of Bobinskaya (1959) showed, the result of shallow working of the soil appears to be a more superficial distribution of all the soil fauna (elaterid larvae, hibernating larvae of the wheat thrips, Hessian fly pupae in wheat stems, etc.). This treatment exposes them to the destructive action of low temperatures during the period of hibernation and makes them more easily available to various predators, principally ground beetles, which in soil cultivated according to Mal'tsev's method, increase considerably in numbers.

The replacement of crop rotation by summer wheat stands determines, in many respects, the composition of the oligophagous pests and introduces a real threat to the grain harvest. Evidently, the species completing their life cycle on one species of food plant and having one generation per year will have the advantage here. To such species belong the gray grain moth, accumulating numbers of wheat thrips, wheat stem chrysomelids, and also bugs of the genus Aelia, together with other stink bugs, the damage from which is already evident in the baking qualities of the flour.

Obviously, a more favorable result follows the establishment of species which pass through a few generations annually, strictly tied to a fixed phase of food plant (Swedish fly and species biologically allied to it) and requiring the simultaneous presence of summer and autumn wheat for completion of the life cycle. Among the polyphagous, soil-inhabitating pests the larvae of the elaterids Selatosomus latus F. and Agriotes sputator L., widely distributed here, can be a serious threat, especially during the first years of working long-fallow grassland. The heaviest damage from these latter pests may be expected on maize stands, the area of which, in the zones in question, will be greatly expanded and brought up to 4.5 million hectares in the next three years.

Within cultivated mountainous districts on uncultivated areas of virgin and long-fallow lands the formation of foci by the nongregarious locust and the Italian grasshopper (Calliptamus italicus L.) is possible when these insects are displaced by the cultivation of small areas of land exposed, in a number of districts, to excessive precipitation.

Thus, the narrow specialization in farming and the covering of large areas with stands of summer wheat lead to a specialization in the fauna, create a prerequisite for the low ecological stability of the agrobiocoenosis under formation and cause real mass increases in the reproduction of harmful organisms and a seeming element of surprise.

There is an existing opinion that in consequence of single crop agriculture,chemical methods of pest control must be intensified in every way. It is doubtful whether there is a single, sound method for the solution of the problems. One should take into consideration that treatments with insecticides and herbicides bring about an effect similar to that which single crop culture causes, that is, the impoverishment of species-diversity in the agricultural landscape and an increase in the number of vacant ecological niches.

The most significant of the fundamental questions dealing with the solution of the problems of grain harvest protection in regions where virgin and long-fallow lands are being cultivated are the following:

First and most important question – the regulation of agrotechnics and the exploitation of zonal systems of farm management.

Agrotechnical methods are, above all, essential means of creating on wheat stands conditions sharply differing from those on uncultivated steppes to which are adapted, at the present time, populations of destructive oligophagous insects met with under zonal conditions as "young" pests of agricultural plants. Methods for creating these conditions in the fields during the periods when growing wheat plants are absent are simpler to realize. The entomological ideas of early harvesting and the post-harvest cultivation of the soil are included in these methods as the one brings about a lack of food in the fields over a possibly longer period and the other breaks the normal hibernation of insects. It is more difficult to change the conditions on wheat stands during their growth period. In this connection the questions of sowing dates and varieties of wheat are of very special importance in zonal conditions.

A reduction in the virulence of the damage and a rise in the resistance of plants to damage from the larvae of the gray grain moth, by the bug Aelia and by wheat thrips is attained by decreasing the period between the earing of wheat and the maturation of the grain. A variety and stand of wheat having a much later date of ear formation and a capacity of ripening and maturing quickly suffers comparatively less from damage by these three important pests. It is quite evident that a well-timed harvest leads to similar positive results.

Second question – development of chemical methods of control. Chemical, surface treatments of wheat stands by DDT, metaphos and mixtures of these preparations and also the use of aerosols (solutions of DDT in diesel oil) at present appear to be essential in the program of measures devised for the control of the gray grain moth on virgin lands.

With existing technical, farm equipment, in localities where focal points of infestation by this pest exist, the carrying out of important agrotechnical measures such as the securing of a well-timed harvest and the autumn cultivation of the soil, which are of decisive importance in pest control, stand in direct relation to seasonal weather conditions. It is precisely this reason why it is necessary to turn to chemical, surface treatments and to plan them on a very large scale. In 1958 only three million hectares were treated by aeroplane and by surface machines and only 2 ½ million hectares in 1959. These measures certainly played an important part in the protection of the harvest. During these two years the expenditure on chemical control amounted to only 10% of the value of the preserved harvest. However, one should not estimate the value of these treatments by the above-mentioned assessment. They function as a protection for the harvest only during the year of application and cannot, in the long run be considered as a factor controlling the increase of harmful insect species in regions where virgin and long-fallow lands are being cultivated.

The significant rise in the level of general farming in the current seven-year period and the increase in the technical equipment of farms on long-fallow lands allow, evidently, a considerable reduction in the volume of surface, chemical treatments and increase the role and importance of chemical prophylaxis. Simultaneously, the methods for treating seeds before they are sown, by preparations of complexing activity, and the machinery for carrying out the treatments can be perfected.

Finally, the third question – the development of methods for introducing variety into the farming landscape.

The aim here is to raise the ecological stability of the agrobiocoenoses, to reinforce the effects of parasites and predators and to prevent the sudden increases in the numbers of cereal pests.

The question of the necessity of reconstructing the agricultural landscape with the object of raising the stability of the agrobiocoenosis is discussed in the literature, in particular by Stark (1959), Elton (1958) and others, and is of great importance in the specialization of farming and in the development of single crop farming.

As a first move towards this goal it is possible to make use of crop stands within large areas of wheat and to surround them with ribbonlike fields of sunflower and other nectar-bearing flowers or perennial legumes such as sweet clover, sainfoin or lucerne. The problem can be solved further by the introduction of belts of woody and shrubby plants in association with flowering gramineous plants.

It is clearly evident that for the solution and practical realization of these problems it is necessary to attract specialists in the various fields of study – entomologists, botanists, foresters, geobotanists and others.

LITERATURE CITED

N. M. Aleinikova, "Methods for establishing the insect fauna on field-protected plantations in Tatar ASSR and for protecting the plantations from pests," Uch. Zap. Kazansk, Gos. Univ. im. Ul'yanova-Lenina, 113, 1, 133 (1953).

N. Anisimov, "Utilization of virgin lands – large-scale reserves for the increase of agricultural products," Kommunist 18, 10 (1959).

V. P. Antonova, "New pests of pasture grass in the Zavolzh'e estuary," Sb. Tr. Moldavsk, St. Zashch. Rast. 3, 217 (1958).

K. V. Arnol'di, "Interpreting zonal principles for the utilization of new insect groupings and the colonization of forest plantations by xerophilous species in the afforestation of the steppe," Zoolog. Zhurn. 31, 1, 3, 329 (1952).

K. V. Arnol'di, "The origin of the wooded steppe and the nature of the penetration into the steppe of forest insects during steppe afforestation," Zoolog. Zhurn. 32, 2, 175 (1953).

G. Ya. Bei-Bienko, "The division of agricultural crops into districts according to pest complex (for example, the biocoenosis of the wheat field)," Zap. Leningrad, s. – kh. Inst. 3, 123 (1939).

G. Ya. Bei-Bienko, "A few entomological problems connected with the question of increasing the productivity of farming," Zoolog. Zhurn. 32, 5, 961 (1954).

G. Ya. Bei-Bienko, "The theory of the formation of the agrobiocoenosis: certain principles concerning the changes in the insect fauna and other invertebrates in the utilization of virgin land," Tez. Dokl. III Soveshch. Vsesoyuzn. Entom. Obshch., 1, 76 (1957).

G. Ya. Bei-Bienko, "The principle of mixed stands and the problems of initial species divergence," Zhurn. Obshch. Biolog. 20, 5, 351 (1959).

G. Ya. Bei-Bienko, T. G. Grigor'eva and I. A. Chetyrkina, "Characters of the terrestrial and subterranean faunas in the biocoenosis of the Orenburg steppe near the suburb Soverovk, Khalilov district," Itogi n.-issl. rabot VIZR for 1935: 78-82, (1936).

V. M. Berezina, "Changes in the insect fauna of the soil in connection with its transition from steppe to forest conditions," Éntom. Obozr. 27, 1-2, 77 (1937).

V. M. Berezina, "Changes in the composition and numbers of soil insect pests following the transformation of the Kamen steppe," Éntom. Obozr. 32, 3 (1959).

S. G. Bobinskaya, "Influence of T. S. Mal'tsev's systems of soil cultivation and cropping on the development and survival of destructive and beneficial insects," Zoolog. Zhurn. 38, 11, 1601 (1959).

Ch. S. Elton, "The ecology of invasions by animals and plants, London: 1-181 (1958).

M. S. Gilyarov, "The chief characters of harmful insects which become adapted to the rotation of field crops," Doklady Akad. Nauk SSSR, 47, 3, 217 (1945).

M. S. Gilyarov, "Entomological problems connected with new systems of soil cultivation," Zoolog. Zhurn. 34, 2, 241 (1955).

T. G. Grigor'eva, "Pests of ceral grasses in the biocoenosis of the virgin steppe," Itogi n.-issl. Rabot. VIZR for 1936, 1, 82 (1937).

T. G. Grigor'eva, "Dynamic principles of the soil fauna in relation to changes in plant covering," Avtoref. Dissert., Vsesoyuzn. Inst. Zashch. Rast., 1, (1951, Leningrad).

A. F. Kipenvarlits, "The change in the soil fauna of marshland under the influence of measures for improvement," Zoolog. Zhurn. 32, 3, 348 (1953).

N. V. Kurdyumov, "The wheat sawfly (Pachynematus clitellatus Lepeletier)," Tr. Poltavsk. s.-kh. op. st. 7, 4, 17 (1912).

V. N. Shchegolev, "New systems of soil cultivation and questions of agricultural entomology," Zoolog Zhurn. 34, 3, 481 (1955).

V. N. Stark, "The problem of afforestation on the steppe and entomological questions connected with it," Izv. Vsesoyuzn. geograf. Obshch. 81, 3, 290 (1949).

V. N. Stark, "Fundamental questions in forest entomology in connection with the seven year plan of development in the national economy of USSR," Zoolog. Zhurn. 38, 7, 961 (1959).

V. I. Tanskii, "The wheat thrips in regions where virgin and long-fallow lands are being cultivated in northern Kazakhstan" Avotr. dissert. Vsesoyuzn. Inst. Zashch. Rast. (Leningrad, 1959).

Chao Tsien-ming, "Biocenosial ties among insects in maize fields" Avtoref. Dissert. Mosk. Gos. Univ. (1959).

G. A. Yatskaya, "Damage by the cereal stem bug to varieties of summer wheat in the Kurgan region in relation to the date of sowing" Tez. Dokl. IV S'ezda Vsesoyuzn. Entom. Obshch., 2, 114 (1959).

Ch. S. Elton, " The Ecology of Invasions by Animals and Plants", 1, (London, 1958)

ON THE EVOLUTION OF THE LEG IN TRACHEATA

Part I. The Subcoxal Theory And Its Criticism

É. G. Bekker

Translated from Entomologicheskoe Obozrenie, Vol. 39, No. 3, pp. 521-528
July-September, 1960

Present ideas on the formation of the leg of arthropods in general and insects in particular are reflected in the so-called "subcoxal theory." As the name of the theory indicates, the formation of the insect leg is related to that part of the body segment exoskeleton which Heymons (1899, 410) called the subcoxa, that is, that part of the pleural skeleton which in the tracheates is located at the base of the leg.

The origin of the pleural sclerites is attributed by Heymons and other proponents of the subcoxal theory partly to the tergal and sternal plates and partly to the coxa of the leg. In ascribing to the subcoxa an origin from the coxal part of the leg, the subcoxal theory relies on data from the embryological investigations of Heymons (1899), according to which the basal part of the coxa splits off and becomes a pleural sclerite in the embryo of one of the Rhynchota. On the basis of other embryological data of Heymons the subcoxal theory proposes that the pleural skeleton in general is formed secondarily between the two primary sections of the segmental skeleton, that is, between the tergal and sternal plates.

The elaboration of the subcoxal theory belongs primarily to Börner. Börner (1905) and Verhoeff attempted more precisely to determine the origin of the pleural skeleton as derived from an interpretation of Heymons' embryological data.

As a demonstration of the fact that the subcoxal sclerites originated from the coxa Börner refers to the participation of these sclerites in the formation of the basal articulation of the coxa. Proceeding from this consideration, Börner considers the subcoxa to be made up of an episternum and epimerum, forming the upper articulation of the coxa, and a trochantinus, forming its anterior (according to Börner inferior) articulation (Börner, 1913, 655 - 656). Imagining the original subcoxa to have been in the form of a complete skeletal element, a ring enclosing the base of the coxa, Börner stipulates that the subcoxa is found in this form only in the Pantapoda and the Arthrostraca among the Crustacea; in general, however, both in the Crustacea and the Tracheata the subcoxa is represented by separate sclerites which in the insects, according to Börner, are the episternum, epimerum, trochantin, and the products of their subdivision. In cases where the coxa articulates with the sternal plate Börner supposes that the trochantin has become merged with the sternal plate. Börner considers the fusion of the subcoxa with the coxa to be a rare event, an unimportant exception. While retaining Heymons' view on the origin of the pleural sclerites, Börner nevertheless suggests another origin for the subcoxa and the other pleural sclerites. The fact that the subcoxal sclerites accurately fit into the sternal skeleton caused Börner to suggest that these sclerites are splitting-off products (Schnürstücke) from the sternal skeleton (Börner, 1903, 299).* For some of the pleural sclerites, for instance the stigmal sclerites of Chilopoda, Börner suggests a separate origin independent of the sternal or tergal plate or the leg, namely the result of the local sclerotization of the pleural membrane between the tergal and sternal plates; Heymons himself considers the "paratergites" to be split off from the tergite. It is evident from what has been said that Börner was not fully convinced of the correctness of Heymon's views, although he basically adhered to them.

A direct consequence of Heymons' interpretation regarding the origin of the subcoxa is the conclusion that from the moment of formation of the subcoxa the relationship between the leg and the segment changes; the leg becomes independent in its formation from the segment. The question of the subsequent development of the leg, independently of the segment, is the basic theme of a series of papers by the proponents of the subcoxal theory – Börner and Verhoeff. The question before the proponents of the subcoxal theory is: Of what does the original composition of the articulated leg consist and what is its subsequent development?

As Börner suggests, the most ancient types of leg articulation are those which show the widest distribution. These are specifically those which serve to carry out the most essential leg movements. Such an articulation is that of the leg with the subcoxa, that is, the basal articulation by which the leg rotates forward and backward and consequently performs movements in a horizontal plane. The second basic movement of the leg,

* The concept of the "Schnürstücke" was borrowed by Börner from Heymons, who named "paratergites" of the pleural sclerites and saw them as fission products of the tergite (Heymons, 1899, 372-374).

which is carried out by the articulations of the coxa and trochanter, is raising and lowering, that is, movement in a vertical plane. In this up and down movement the distal part of the leg participates, that is, that part of the leg which after Verhoeff has been called the "telopodite," which is opposite to the "coxite," or coxal section (Verhoeff, 1903a).† The third basic movement of the leg, which also takes place in a vertical plane, is performed by the articulation of the femur and tibia, that is, the knee articulation.

The three principal leg articulations indicated connect the three parts of the leg together – the coxal, trochantero-femoral, and tibio-tarsal segments, which, together with their three articulations, the proponents of the subcoxal theory consider to be segments and articulations of primary significance, the other articulations being considered by Börner to have been formed secondarily or tertiarily as a result of the secondary subdivision of the trochantero-femoral and tibio-tarsal segments.

Börner ascribed primary significance to the three segments indicated on the basis that in the normally articulated legs of all "true" arthropods their articulation is distinguished by greater structural constancy, whereas the structure of the other types of articulation show great variation, thus making their homology difficult. According to Börner, these primary leg segments are not only characterized by the direction of reciprocal movement, but also by the fully distinct type of structure of the segmental articulation and also the order in which these three articulations are located.

The first type of articular structure is described by Börner as the dicondylic hinged articulation. This type of structure is characterized by the fact that at the ends of the two leg segments which combine to form the articulation there are two opposed pivotal points on each, through which the axis of rotation runs. These two opposed pivotal points of the articulation are located either at the upper and lower parts of the articulation, as occurs at the basal articulation of the leg, or at the anterior and posterior parts of the articulation, as occurs at the coxo-trochanteral joint. Thus, these two articulations have a strictly determined location for the two pivotal points, through which the axis of rotation runs, which determine that the movement of the coxal segment will be in a horizontal plane and the movement of the "telopodite" will be in a vertical plane. Also, the third primary articulation, namely the knee joint (femoro-tibial), has its own characteristic structure, a monocondylic articulation in which the femur and tibia have only one common pivotal point in lieu of the two pivotal points of the dicondylic articulation; the pivotal point of the knee articulation is located at its upper part. Börner indicates that the monocondylic knee joint developed from the dicondylic one with the anterior and posterior location of the two pivotal points; these two pivotal points became approximated at the upper side of the articulation and there united into a single common pivotal point. Börner imagines that the formation of the monocondylic articulation from the dicondylic could also take place in another way, namely, through a loss of one of the two pivotal points of the dicondylic articulation; in this case the structure of the pivotal point is simpler. A monocondylic articulation with this origin not only allows a leg to bend in different directions but also enables the distal part of the leg to rotate, if the corresponding muscle is present. Aside from the types of articulation listed, Börner distinguishes an additional syndetic hinged articulation, in which at one side of the articulation the edges of the two segments forming it come together for some distance when the leg extends, thus setting a limit to the extension. The articulation of the trochanter and femur of insects has this structure. Thus all types of articulation, in Börner's opinion, arose from the dicondylic, which he considers to be the primary form of articulation.

The dicondylic articulation evolved in its turn from the acondylic, according to Börner, that is, from an articulation of the ends of the two leg segments which is devoid of specially formed pivotal points; with the corresponding distribution of muscles such an acondylic junction of the two leg segments should permit flexion in any direction.

Thus, Börner considers that the types of articulation cited above and their regular distribution along the leg enable one to carry out an accurate homology of the leg segments. In this author's opinion, these segments were originally three, namely; the coxa, trochanterofemur, and tibiotarsus, of which the last two represented parts which were still whole and undivided into trochanter and femur or tibia and tarsus. Each of the three primary

† We might point out that this division of the leg into two segments does not have sufficient basis; indeed, the "biological" significance of this articulation, and in particular the loss of the distal part of the leg (the "telopodite"), entails a break at the coxo-trochanteral articulation which in the Tracheata is not at all constant; in many cases the separation of the distal part of the leg does not take place at this articulation but at the distal articulation of the trochanter, that is, at the articulation of the trochanter with the femur, which does not argue in favor of the indicated division of the limb. This division of the leg, as will be seen later, is not justified by the origin of the two basal segments of the leg either; their origin contradicts such a division.

segments had the structure described above. We might point out that in accordance with the primitive leg characters described above Börner saw the arthropod leg prototype realized in insects with fused tibia and tarsus, as in the Collembola, and fused trochanter and femur; thus, secondary modifications in the form of fusion of leg segments have some kind of genetic relation to the primitive conditions of the leg (Börner, 1913, 659). Börner believes that the musculature of the leg has less importance in homologizing its segments. He considers that the "primary muscle segment" of the leg is composed of the flexor muscle and the extensor muscle, which opposes the flexor. The dicondylic articulation evidently corresponds to such a "muscle segment."

While Börner strives to base the homology of the leg segments on the structure of the articulation, Verhoeff attempts to use the leg musculature for the same end (Verhoeff, 1903b). Verhoeff distinguishes three groups of leg muscles: 1) a group of "direct" leg muscles – muscles which are arranged in only one of its segments; the insertion of such muscles are found at the distal articulation of this segment; 2) a group of "projected" muscles; a projected muscle is arranged along two or more leg segments; hence, the muscle is projected across one or more articulations; and 3) the pretarsal flexor muscle, consisting of several muscle bundles, distributed over two or more leg segments, and connected by a common tendon the insertion of which is located on the pretarsus. Verhoeff proceeds from the preconceived notion that a muscle growing out from its origin in the direction of the leg base is incapable of traversing the articulation in its course; in his opinion, the articulation thus sets a limit to the migration of the muscle origin. Hence Verhoeff considers the pretarsal flexor muscle to be the oldest muscle in the leg, the contractile branches of which may be distributed over all the segments of the leg. Basing himself on the opinion that the origin cannot migrate across an articulation to segments located closer to the base of the leg, Verhoeff came to the conslusion that this muscle must have existed before the formation of all the joints across which its tendon runs. On this same basis Verhoeff considers the youngest muscle to be the "direct" muscle, the "projected" one being considered intermediate in development: it was originally "direct", then became "projected" after the formation of the articulation across which it is projected. Utilizing primarily the group of projected muscles, Verhoeff attempts to establish a homology for the leg segments and their stages in the Opisthogoneata. Like Börner, Verhoeff imagined a prototype of the arthoped leg consisting of a limited number of segments, namely, a coxa, trochanterofemur, femur, and tibia (+ tarsus).‡ Thus Verhoeff also considers the more fully segmented condition of the leg to be secondary.

We have presented above the basic features of the subcoxal theory. In the following account we will discuss those questions which we believe to have been incorrectly resolved by the proponents of this theory.

It was shown that the subcoxal theory arose from embryological data as interpreted by the embryologist Heymons. May it be asked whether Heymons correctly interpreted these embryological data?

Heymons interpreted one of these observations to the effect that a part of the coxal segment of the leg separates off and becomes a part of the pleuron; this part Heymons called the subcoxa from its position at the base of the coxal segment. Doubt arises as to the correct interpretation of this event by Heymons because such an interpretation runs counter to the entire process of leg formation from the moment of its first appearance. Actually, the precursor of the articulated leg – the parapodium of the annelid worms – arose as an outgrowth of the pleural part of the segment. Further development of the parapodium in connection with the transition to terrestrial existence produced the leg of the Protracheata, the structure of which confirms the fact that its increase in size represents its further growth at the expense of the segment; this is particularly indicated by the position of the opening of the segmental organ, which migrates from the segment to the base of the leg, while on the fourth and fifth segments (sometimes also the sixth and seventh) this opening becomes transferred to an even more distal part of the limb. It may be presumed that as this migration attests to a transferral part of the segment into the composition of the leg, the segment will play a similar role in the further development of the leg. On the other hand, according to Heymons' interpretation in the Rhynchota the reverse process takes place, that is, part of the coxal segment of the leg migrates into the pleuron. Thus, what occurs is technically a shortening of the leg and a growth of the pleural part of the segment at the expense of the leg, this being in contradiction not only to the entire process of its development but also, in particular, to the previous history of its development. It may be expected that Heymons having considered this contradiction, would have worked the problem out with more material and discussed his reasons, which would have made his interpretation of the embryological observations more understandable and acceptable. We do not see this, however; upon one

‡ Verhoeff also gave some other variants of the primary condition of the leg; thus, he indicates the coxa, femur, tibia, and tarsus to be the oldest segments, considering the second tarsal segment to be of medium age and the trochanter the youngest. The author judges age according to the development of the articular membrane and the presence or absence of muscles serving the articulation (Verhoeff, 1902).

observation, arbitrarily interpreted, the entire "subcoxal theory" is constructed. In fact, the event observed by Heymons may be perfectly adquately explained as the reverse process of that which Heymons and the other proponents of the " subcoxal theory proposed." Thus, the observed embryological event may be interpreted, not as a separation of part of the existing coxal segment of the leg and its entry into the composition of the pleuron (which runs counter to the preceding history of leg formation), but as a process of formation of the coxal segment at the expense of the pleural part of the segment, which agrees with the preceding history of leg formation. Later we will provide proof that this does in fact occur in this manner, but now we will turn to Börner's attempt to confirm the correctness of Heymons' interpretation. Börner found that the articulation formed by the "subcoxal sclerites" (the episternun, epimerum, and trochantin) with the coxal segment show that these were once part of this segment. Can we agree with this ? The articulation of one with the other is not formed of parts of a single whole, but actually of two independent parts of the skeleton which are movable in relation to each other. Hence we can more correctly defend the view opposite to that which Börner wished to demonstrate with regard to the articulation of the coxal segment with the parts of the subcoxa.

Heymons attempted to show with embryological material not only that the subcoxa is a collection of pleural sclerites which have formed secondarily at the expense of nonpleural exoskeleton, but that the whole pleuron in gneral, with its sclerites, is a secondary formation wedged in between the two original sclerites the tergal and sternal plates. In his opinion the sclerites of the pleuron, excluding those of the subcoxa, broke off from the tergite. He states in one of his embryological works that "the pleurites in the centipede are formed at the expense of the tergite rudiments" (Heymons, 1898, 246). It might be pointed out that many authors take Heymons' position not only with regard to the pleurites of Chilopoda, but with those of insects as well. Did Heymons have the right to maintain this on the basis of his embryological data, in such categorical form besides? In order to avoid any sort of doubts which may arise, I will use the same material henceforth which Heymons used, namely, chilopods in general and the centipede (Scolopendromorpha**) in particular, adhering to the view that the Chilopoda are ancestral to the line which eventually led to the insects. As is well known, Heymons and Verhoeff held this opinion on the origin of insects from myriapods in opposition to Börner.

Heymons (1901, 33-36) indicates that towards the beginning of segmentation in the centipede the germ band is laid down from an unpaired median band, which subsequently develops into an unpaired median longitudinal band on the sternal plate of the adult individual, and from a paired lateral band. The lateral margins of the lateral bands are connected together by an ectodermal dorsal membrane or the embryo which in the adult provides the median longitudinal band of the tergal plate. It should especially be noted that the median ventral band and the dorsal membrane are directly transformed into the median band of the sternal plate and the median band of the tergal plate, and are consequently rudiments of these parts of the sternal and tergal plates. The paired lateral band of the embryo, as Heymons states further along, shows segmentation in the form of tubercles, on each of which a leg rudiment arises. At the appearance of the leg rudiments segmentally on each lateral band three parts may be distinguished, according to Heymons; these are 1) the limb rudiment; 2) a part contiguous to the limb laterally, Heymons called this lateral part the "tergite rudiment" although this rudiment does not develop only in the lateral longitudinal bands of the tergite but also on the upper part of the pleuron, where the stigmal sclerite is situated, surrounded by the pleural sclerites; and 3) the part of the lateral band of the embryo which is contiguous to the leg rudiment on the medial side and which develops into the lateral longitudinal bands of the sternal plate in the adult. Heymons calls this part of the lateral band of the embryo the "sternite rudiment." We might point out that both the "tergite rudiment" and the "sternite rudiment" of Heymons only supplement the tergite, which is represented in the embryo by the median band of the germ band, forming its lateral portions.

We might mention Heymons' remark that in the early stages of development the lateral band of the emryo possesses thickened epithelium, whereas the unpaired sternal and tergal bands have flat epithelium. Thus, in distinguishing "tergite rudiments" and "sternite rudiments" as parts of the lateral band Heymons completely forgot about the two unpaired bands which show outlines of the tergite and sternite of the segmental skeleton from the first appearance of the germ band; he called parts tergal and sternal rudiments when they were initially clearly separated from the unpaired bands, possessed a different sort of epithelium, and gave rise to the pleuron with its included limb. Evidently this lateral band, as distinct from the unpaired bands which, as Heymons points out, preserve delicate cuticle, may quite correctly be called the rudiment of the pleuron and leg, which secondarily sends parts towards the tergite rudiment and sternite rudiment – parts which are transformed into the lateral bands of the tergite and sternite in the adult. Should it not then be recognized that Heymon's interpretation is illogical and preconceived? Also illogical is Heymon's opinion that the pleuron arose from the "tergite rudiment." Heymons' conclusions are the reverse of those provided by his very own embryological observations, which clearly show

** As in original - Publisher's note.

that in the process of development the pleurite rudiment gives rise to the paired lateral portions of the tergite and sternite. ††

We will now turn to the ideas of the authors of the subcoxal theory on the original structure of the articulate leg and its subsequent modifications. It is difficult to imagine that the prototype articulate leg was as perfect both in the structure of its articulations and in its general formation as that which Börner outlined for us. Can we agree that the dicondylic articulation was the original one when it appeared in the arthropods? In fact the dicondylic type represents the most perfect form of articulation in the arthropods both with regard to the accuracy of the movements it performs and the efficiency of the distribution of its musculature to economically utilize muscular strength. Börner proposes that the dicondylic articulation directly preceded the acondylic union of leg segments in which there are no specialized pivotal points, that is, no ball-and-socket combination. It is logical to suppose that the acondylic union of leg segments is at a lower stage of joint formation and was not suddenly replaced by a higher form of articulation, such as the dicondylic one, but that there was at least one intermediate form between them, such as the monocondylic articulation, which could in its turn show variations in structure, location, and arrangment. It would have been natural for the monocondylic articulation, which performed inaccurate movements to become refined in its turn into the dicondylic articulation. Börner, however, believes that the process of articulation replacement was the reverse one, that the dicondylic was developed into the less perfect monocondylic one. Börner refers to the fact that the dicondylic articulation is particularly widely distributed; in his opinion, the wide distribution of the dicondylic articulation attests to the great age of this type. It can, however, be supposed that the wide distribution of the dicondylic articulation is not a consequence of its relative age but of its efficiency and high adaptive value, as a result of which it has replaced other types of articulation. It would have been strange if the less perfect monocondylic articulation had replaced the dicondylic.

By following the principle that the less perfect apparatus must make way for the more perfect one, it is difficult to admit that the original articulate leg was constructed as economically and efficiently as Börner imagined it, i.e., that it consisted of a total of three segments provided with such perfect articulations. We may suppose not only that the articular structure was simpler and less perfect, but that the articulations themselves and the segments were more numerous and that there were articulations and segments which performed similar movements, directly following one another. The fixation of such an arrangement would have consisted of a successive correction of the movement performed by another articulation while the type of articulation was as yet imperfect. This would correspond to what is in fact observed in the lower arthropods, such as the Arthrostraca among the Crustacea or many Myriapoda among the Tracheata. Börner himself points to instances of similarly constructed and similarly functioning leg segments succeeding one another, explaining these instances as secondary subdivisions of an original single segment, but he does not explain the mechanism by which such a subdivison might take place. It is not difficult to imagine the disappearance of superfluous articulations and the fusion together of identically functioning segments as the general articulation improved; however, this could occur with the result that the function of the leg becomes simplified, as happens in the Collembola, for example. It seems strange that Börner should attempt to refer to such clear instances of simplification of leg structure as demonstrations of an original simple leg structure of three segments; it is impossible to consider the secondary fusion of tibia and tarsus in the Collembola as the development of a tibia and tarsus from a single tibiotarsal segment!

The attempts of the authors of the subcoxal theory to employ the muscle distribution of the leg in order to determine the age of its segments did not give the results and could not give them, since the principle on which Verhoeff based his conception, that the origin of the leg muscle, when migrating towards the base of the leg, is unable to cross the articulation, is incorrect as Börner also noted. In one of the subsequent portions of our work we will show instances when the muscle origin migrates from one skeletal part to another.

In summing up the above, it should be recognized that both the subcoxal theory and the related concepts of the authors of this theory on the composition of the primitive articulate leg are in error, since the conclusions at which these authors arrive do not agree either with the facts of ontogenesis or with comparative anatomical data.

Having set forth and criticized the dominant concepts on the origin of the pleuron and the formation of the articulate leg, in the subsequent portions of the present work we will discuss our own opinions on these questions, based on comparative anatomical investigations of tracheates.

LITERATURE CITED

C. Börner, Kritische Bemerkungen über einige vergleichend-morphologische Untersuchungen K. W. Verhoeffs, Zool. Anz. 26, 290 (1903).

C. Börner, Sammelreferat über die Arbeiten von 1902-1905. Biol. Centralbl. 12, (1905).

†† We will return later to the basis for taking this position.

C. Börner, Die Gliedmassen der Arthropoden. In: Lang. Handbuch der vergleichenden Anatomie der wirbellosen Tiere. Arthopoda (1913).

R. Heymons, Zur Entwicklungsgeschichte der Chilopoden Sitz.-ber. Preuss. Akad. Wiss. p. 244 (1898).

R. Heymons, Beiträge zur Morphologie und Entwicklungsgeschichte der Rhynchoten. Nova Acta. Abh. K. K. Leop. Carol. Akad. Naurf. 74, 1 (1899).

R. Heymons, Die Entwicklungsgeschichte der Scolopender, Zoologica 13, 33 (1901).

K. Verhoeff, Beiträge zur vergleichenden Morphologie des Thorax der Insekten mit Berücksichtigung der Chilopoden. Nova Acta. Abh. K. K. Leop. Carol. Akad. Naturf. 81, 63 (1902).

K. Verhoeff, Über Tracheaten-Beine. 2. Aufsatz. Trochanter und Praefemur. Zool. Anz. 26, 205 (1903a).

K. Verhoeff, Über Tracheaten-Beine. 4 und 5 Aufsatz. Chilopoda und Hexapoda. Nova Acta. Abh. K K. Leop. Carol. Akad. Naturf. 81, 4, 211 (1903b).

GALL-LICE (HOMOPTERA, PHYLLOXERIDAE) IN ARTIFICIAL PLANTATIONS IN THE UKRAINE

G. V. Dmitriev

Translated from Éntomologicheskoe Obozrenie, Vol. 39, No. 3, pp. 529-544
July-September, 1960

The very great importance of gall-lice (Phylloxeridae, Chermesinae) in the life of many conifers, the scarcity of published information on their species and occurrence in the European USSR, and the absence of effective measures for their control have led us to publish some of the results of the work which we carried out in 1953-1958 in parks and other artificial plantations in the forest-steppe and steppe zones of the Ukraine (Dmitriev [1958]).

Seventeen species of gall-lice have been recorded in Central Europe (Börner [1952]); for the European USSR 14 species are definitely known (Kholodkovskii [1915, 1929], Mordvilko [1929, 1948], Stark [1931], Yatsentkovskii [1931], Shaposhnikov [1950, 1955]); within the Ukraine the gall-lice fauna has received little study (Pospelov [1909], Dobrovlyanskii [1915], Klodnitskii [1921], Padii [1953], Mamontova [1956]); we have recorded 17 species of the family Chermesinae, living on firs, Douglas fir (Pseudotsuga), spruces, larches and pines. These species are as follows.*

*1. Pineus pini Macq. (= P. pini pini Marshal; Chermes pinicola Chol.) – The pine chermes. Widely distributed. In the forest-steppe zone, centers with very large numbers were common, especially in young plantations. In the steppe zone there were scattered small centers with a small population. We did not find it in the subzone of dry feather-grass, steppe-fescue steppes. It was very rare in the Carpathian districts. It develops in large numbers only on Pinus silvestris, very rarely on Pinus montana. Sexuparae were observed only in parks on the left bank forest-steppe; cases of finding galls typical of this species on Picea excelsa and P. obovata were very rare even in centers with large numbers. The pine chermes, once it has settled in a plantation, very rapidly (within 3-4 years) increases its numbers to mass proportions. Colonization of the shoots and growth of the preceding two years arrests the growth of the shoots and branches and the needles on infested trees curl up and turn pale. It is especially destructive to young trees (3 to 20 years old). Trees weakened by the pine chermes are soon colonized by the blue pine weevil (Magdalis frontalis Gyll.) and bark beetles (Blastophagus sp.).

2. P. orientalis Dreyf. (= P. pini orientalis Marshal) – The eastern pine chermes. Of very rare occurrence. The galls typical of this species were found only in some parks of the forest-steppe zone, on Picea orientalis and P. excelsa (two cases altogether.)

3. P. cembrae Chol. (= Chermes sibiricus Chol.) – The Siberian chermes. Parthenogenetic females of this species were found in a few parks in the forest-steppe zone, on Pinus sibiricus trees, which are occasionally found there. Only on two occasions, on Picea excelsa and P. obovata (Trostyanets tree park), did we manage to find the characteristic elongate, bent, one-sided crumbly galls of this species.

*4. P. strobi Hart. (= Chermes corticalis Kalt., Ch. pinicorticis Fitch).–The Weymouth pine chermes. Widely distributed. Centers of very large numbers were found in most parks of the forest-steppe zone. Frequently the infestation of the trees was so great that the waxlike excretions of the gall-lice colonies coated the trunk, boughs and side branches in such a solid layer that the trees appeared covered with snow, with the surface of the soil and herbage under the crown being covered with an almost solid carpet of fallen "fluff." Heavily infested trees (even century-old ones) have an abnormal threadbare crown, pale stunted needles, stunted shoots, and exude much more resin. We recorded cases where 30-50 yearold trees, which had been heavily infested for three to four years, dried up in the fourth or fifth year. In young trees the stoppage of shoot formation is particularly noticeable. The needles on the branches and shoots colonized by the chermes become yellowish green and dull, and the crown is disfigured.

5. P. pineoides Chol. (= Chermes pineoides Chol.)– The spruce bark chermes. We recorded this species only on Picea excelsa, on the smooth bark of the upper half of the trunk in folds and under the scales of thicker bark. It was found only on very old trees in a few parks and in small centers with very low numbers.

*6. Dreyfusia nordmannianae Eckst. (=Chermes funitectus Chol., D. nüsslini CB) – The caucasian fir-spruce chermes. Before 1958 the only place where this species was found on Abies nordmanniana and Picea orientalis was in Trostyanets tree park; the characteristic carmine-red galls on the oriental spruce were rare

* The most injurious species are indicated by asterisks.

(Fig. 1) (1952 and 1954), but the infestation of the needles of the Nordmann fir was appreciable and considerable numbers of fundatrix larvae wintering on the bark of shoots and thin branches were noted (1953 and 1955). In 1958 the wintering larvae of this species were found on young A. nordmanniana trees in the Botanical Garden of the Academy of Sciences, Ukrainian SSR (Kiev), where seedlings of P. orientalis and A. nordmanniana had been brought in from Teberda. The caucasian chermes is particularly destructive to young trees; on shoots colonized by the larvae, the needles curl up, turn pale and dry up (Fig. 2).

7. D. piceae Ratz. (= Chermes piceae Ratz., Ch. bouvieri Chol.) – The fir bark chermes. Found in very small numbers on a few old Abies alba trees in parks in the Carpathian zone; in the forest-steppe zone it was found only in Trostyanets tree park, where it formed isolated very small centers on A. alba and A. balsamea; it was absent in the steppe zone.

*8. Aphrastasia pectinatae Chol. (= Chermes coccineus Chol.) – The Siberian fir-spruce chermes. Widely distributed. Centers with large numbers were found only in a few parks in the forest-steppe zone, where it lives on Abies sibirica, A. alba, A. balsamea, A. concolor A. fraseri, Picea excelsa and P. obovata. It is a very dangerous pest of firs; it multiplies in mass by generations of colonists (exules), particularly on A. balsamea, A. sibirica and A. fraseri A few galls were noted on spruces in a few parks. The widespread drying-up of the May shoots in centers with large numbers was a common occurrence.

*9. Aphrastasia sp. (= ? funitecta Dreyf., Adelges tsugae Annand.) We first discovered this species on very old Douglas firs (Pseudotsuga taxifolia) in an old park in Mezhenetz, Drogobych Region. The larvae fed on the underside of the needles, and here we observed parthenogenetic females and small clusters of brown eggs. These gall-lice were not found on spruce or fir in this park, but the infestation of P. taxifolia was very heavy. Morphologically, and in the way they colonize the needles, the species resembles A. pectinatae. The conspicuous centers of very large population on individual trees 100 years old or more, with the total absence of the louse on trees growing alongside, the absence of the louse on firs and spruces in this park, and the fact that it undoubtedly belonged to the genus Aphrastasia, indicated that this species had originated from N America, where Aphrastasia species have been recorded on Tsuga and Pseudotsuga. The infested trees were heavily covered with the "fluff" excreted by the lice and the grayish white "fluffiness" of the branches attracted notice from a distance. In the words of workers on the state farm which was in charge of the park "this mold is observed on certain firs every year." We were the first to find this gall-louse on Pseudotsuga on the territory of the European USSR and in the countries of Eastern Europe

*10 Cholodkovskya viridana Chol (= Chermes viridanus Chol) – The green larch chermes. Found on Larix sibirica, and occasionally on L. decidua, in

Fig. 1. Galls of Dreyfusia nordmannianae on the oriental spruce.

Fig. 2. Damage to young growth of Nordmann fir (Abies nordmanniana) by the Caucasian fir-spruce chermes (Dreyfusia nordmannianae).

certain old parks in the lowland forest and forest-steppe zones. It has obviously been introduced with planting material, since the centers were very localized. In young plantations in the Botanical Garden Academy of Sciences, Ukr. SSR (Kiev) it was found on L. sibirica seedlings brought from the neighborhood of Moscow; during the last five years the population of this center has greatly increased, but its area has not increased much. On young trees (up to 20-25 years old) the colonization of trunk and branches by the chermes causes increased peeling and cracking of the bark. The young trees – with masses of larvae and fundatrices feeding in the folds and under the scales of the bark– look like failing, aging trees; the needles in such trees curl up, and the growth in height and thickness is retarded. Heavily infested trees are easily recognized by the abnormal cracking and peeling of the bark and by the "taperiness" of the trunk. At the end of spring the larvae which have emerged from the eggs laid by the overwintered fundatrices migrate from the trunk and branches to the young shoots and feed on them; green shoots colonized by the larvae cease to grow and the crown becomes disfigured; the needles on the damaged shoots turn pale and curl up.

11. Ch. viridula Chol. (=Chermes viridulus Chol.) The larch bark chermes. Of extremely rare occurrence. We found it only in the Trostyanets tree park (south of Chernigov Obl.), in an old park at Novochartoriya (southwest Zhitomir Obl.),and in Sanchikov forestry (north Khmel'nitskii Obl.), on Larix sibirica. The whole life cycle is passed under the scales, in folds and crevices in the bark. No winged migrants were observed Prior to this it has been recorded only from the Estonian SSR.

*12. Adelges laricis Vall (=Chermes coccineus Ratz., Ch. strobilobius Kalt.) – The early larch-spruce chermes. Found occasionally in many parks of the forest steppe and lowland forest zones extremely rare in plantations in the subzone of feather-grass, mixed-herbaceous steppe, it was absent in the subzone of dry feather-grass, steppe-fescue steppes. Certain plantations in the forest-steppe zone had centers with large populations. It was recorded on Larix sibirica and L. decidua, on Picea excelsa, P. obovata, and occasionally on Larix leptolepis and Picea canadensis. Mass outbreaks of colonists (exules) on the larch cause drying-up of the shoots.

*13. A. tardoides Chol. (= Cnaphalodes lapponicus CB, non Chol.) – The late larch spruce chermes. Of wider occurrence and always in greater numbers than the previous species. It predominates on the right-bank steppe and in the Carpathian districts. The migration of the winged forms on to larch takes place 30-40 days later than in the previous species. It seriously damages spruce and larch. It lives mainly on Larix sibirica and Picea excelsa.

14. A. lapponicus Chol. (= Chermes lapponicus praecox Chol.) – The early spruce chermes. An uncommon species, occurring in centers with small numbers on Picea excelsa, and occasionally on P. obovata, in a few parks in the forest-steppe zone.

*15. A. tardus Dreyf. (= Chermes lapponicus tardus Chol.) – The late spruce chermes. Widely distributed in all the artificial plantations in the Ukraine, except in the subzone of feather-grass, steppe-fescue steppe. This species and Chermes abietis are the principal and most injurious spruce pests. It occurs in large numbers in nurseries, young plantations, old parks, in shelterbelts lining highways and railroads. It was recorded on Picea excelsa, P. obovata, P. canadensis, P. pungens and other species of spruce. It was not a rare event to find plantations where 50-80% of the leader buds in spruces had been transformed into galls by this species; such trees have a threadbare crown dispersed with galls. They grow badly, become weaker from year to year, and are soon colonized by bark beetles.

*16. Chermes abietis L. (= Chermes abietis Chol.)– The yellow spruce spruce chermes (Fig. 3 and 4). Found in all artificial plantations, except in the subzone of feather-grass, steppe-fescue steppe. It is a very dangerous species for Picea excelsa. This and Adelges tardus are the main culprits in the rapid deterioration and death of young trees. It predominates in young plantations; in old parks it is found on well-illuminated trees and on solitary trees. It forms large, rapidly multiplying, but localized centers It greatly retards the growth of spruces by destroying the young shoots (Figs. 5 and 6), and often transforms most of them into galls; such damage on spruces up to ten years old leads to the death of the trees.

*17. Ch. viridis (= Ch. laricis Htg., Ch. viridis Chol., Ch. occidentalis Chol.) The green larch-spruce chermes. Found everywhere in the forest-steppe zone, and in certain plantations in the subzone of feather-grass mixed-herbaceous steppe. It was not found in the

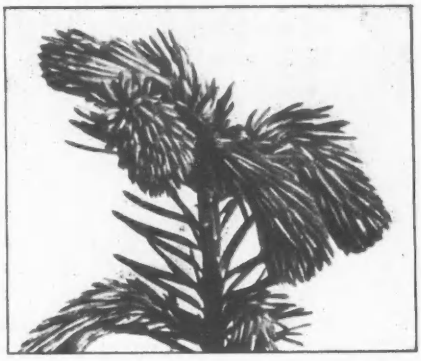


Fig. 3. Formation of primary galls of Chermes abietis on spruce.

subzone of feather-grass, steppe-fescue steppe. There were small centers with very large populations in a few parks. Mass outbreaks have been reported in some parks of the left-bank forest-steppe and in parks in the Carpathian districts. It lives on Larix decidua and L. sibirica, on Picea excelsa, P. canadensis (rarely)and P. pungens (very rarely).

Of the 17 species listed eight (No. 1, 4, 8, 12, 13, 15, 16, and 17) are of particular importance as regards their effect on the longevity and decorativeness of coniferous trees; the other nine species are of wide occurrence, or only sporadic small centers with large numbers are found (No. 9 and 10).

In the tree and shrub planting program of the Ukraine conifers will be widely used and will constitute, in the forthcoming years, up to 25% of the trees in parks and other types of artificial plantations. More than 40 species of conifers, belonging to the genera Abies, Pseudotsuga, Tsuga, Picea, Larix and Pinus, have been cultivated in the Ukraine over a long period (Lypa [1952]). According to our data, gall-lice live on more than 20 species of conifers. These species can be classed in three groups according to their degree of infestation by gall-lice: Group 1 – heavy or mass infestation (apart from subzone of dry steppes), injury so severe that it often seriously affects the growth and life of the trees; Group 2 – light infestation, injury not seriously affecting the life of the trees, or a few centers with large numbers only found in a few separate plantations; Group 3 – infestation insignificant and economically negligible:

Group 1

†Balsam fir (1)
Siberian fir (1)
†Siberian larch (5)
European larch (3)
†Scots pine (2)
†Weymouth pine (1)
†Norway spruce (11)
Siberian spruce (8)

Group 2

†Douglas fir (1)
†Silver fir (2)
†White fir (1)
†Southern balsam fir (1)
Mountain pine (2)
Canadian spruce (3)
Colorado spruce (2)

Group 3

†Nordmann fir (1)
Japanese larch (2)
Siberian stone pine (1)
Black pine (2)
†Oriental spruce (2)
†Red spruce (2)
†Black spruce (1)
Engelmann spruce (1)

We did not find any gall-lice on the following species: eastern hemlock; Andalusian, Arizona and Grecian firs; Yeddo, Himalayan, Alcock's, Schrenk's, and Serbian spruces; and the Macedonian, Crimean and Banksian pines. It should be noted that these species and species of the third group were old or century-old trees, growing in parks in the immediate proximity of species of the first and second groups, i.e., we wish to emphasize here the importance of some specific features of the uninfested or lightly infested species of Pinaceae, since the conditions of existence did not prevent mass multiplication of gall-lice on species of first and second groups. The degree of infestation of the same species of conifer in different natural regions of the USSR varied; and decreased from NW to SE (in the subzone of feather-grass, steppe-fescue, steppe gall-lice were absent). This is evidently due to the dryness of the air in the steppe zone and the distance of the plantations here from the primary biotopes of the gall-lice.

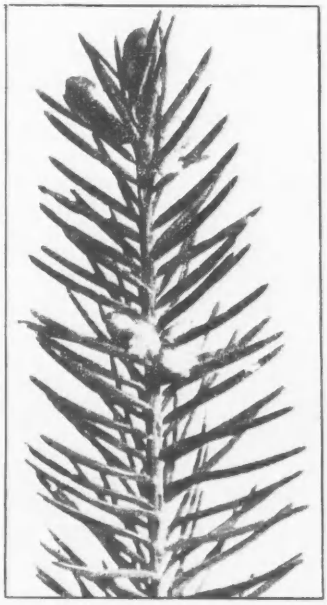


Fig. 4. Fundatrices of Chermes abietis on previous year's growth of spruce.

† A dagger before the name indicates the most damaged species in the group; the figure in parentheses after the name indicates the number of gall-like species which live on this plant.

As we know, gall-lice are the most ancient group of aphids (Mordvilko [1925, 1933, 1935]; Shaposhnikov [1951, 1956]). In view of their close evolutionary link with Pinaceae (see Table) and the trophic relationships of the present-day species of gall-lice we can class them in six biological groups: 1) pine-spruce gall-lice (tribe Pineini), 2) larch-spruce gall-lice (Chermes and Adelges of the tribe Adelgini), 3) fir-spruce gall-lice (Dreyfusiini), 4) spruce gall-lice (some Adelgini and P. pineoides), 5) larch gall-lice Cholodkovskya, Adelgini), and 6) fir gall-lice(Dreyfusiini). This grouping not only stresses the very close association with the tribes and genera of Pinaceae, but is also of practical value; it enables us to predict the gall-lice fauna of an artificial plantation in particular conditions.

The first group consist of species in which the entire life cycle can be passed on Pinus (the presence of Picea in the plantations is not essential). Their powers of migration are limited. The colonization of artificial plantations by species of this group is due to their introduction with planting material.

Species of the second group may multiply for a long time on Larix by means of generations of colonists (exules). Although the natural migration of these species on to Picea is commoner it is not obligatory. Species of this group are more capable of active migration. The sources of invasion by these species are either pure larch stands, or mixed spruce-larch stands, but not pure spruce plantations. The colonization of artificial plantations by Ch. viridis is only possible when they contain spruce and larch.

The third group consists of species for which the presence of Picea in the plantation (in the artificial and primary biotope) is not obligatory. Very large populations are maintained for years by generations of colonists on Abies sp. The centers of invasion and the migration are similar to those of the second group but in this case the host plant is fir instead of larch. Their ability for active migration is less than that of the second group.

The fourth group consists of species which form centers with very large numbers in pure spruce plantations, and none of the other species of Pinaceae are of any significance in the life cycle of gall-lice of this group. They can only appear in artificial plantations if they are introduced with planting material. All the species of this group are very closely bound to the "mother" tree and the biotope.

Fig.5. An eight-year old spruce, not infested with gall-lice. This was planted at the same time as, and close to, the spruce shown in Fig 6. (Photograph 1957).

Fig. 6. An eight-year old spruce which was heavily infested with Chermes abietis and which died in 1958. (Photograph 1957).

Biological Groups of Gall-Lice and Their Relations with Their Host Plants (in brackets – secondary or intermediate hosts)

Gall-lice (Phylloxeridae, Chermesinae)				Host plants in fam. Pinaceae	
tribe	genus	species	biological group	genus	tribe
Pineini	*Pineus* . . .	*pini*, *orientalis*, *cembrae*, *strobi*	1	Pinus (Picea)	Pineae
		pineoides	4	Picea	Abieteae
Adelgini	*Chermes* . . .	*abietis*			
		viridis	2	Larix (Picea)	Lariceae
	Adelges . . .	*tardoides*, *laricis*			
		tardus, *lapponicus*	4	Picea	Abieteae
	Cholodkovskya	*viridana*, *viridula*	5	Larix	Lariceae
Dreyfusiini	*Dreyfusia* . .	*piceae*	6	Abies	Abieteae
		nordmannianae	3	Abies (Picea)	
	Aphrastasia .	*pectinatae*	6	Pseudotsuga	
		funitecta			

Species of the fifth group develop only on Larix; they invade artificial plantations only by introduction with planting material or from primary biotopes of larch, immediately adjacent to the plantation.

The sixth group contains species associated solely with fir, on which populations of these species can live for decades on plants once colonized. They can only appear in artificial plantations by introduction with planting material.

The only species with a very pronounced ability for active migration and which requires for its development the obligatory presence of spruce and larch in the plantation, is Chermes viridis (second group); the colonization of artificial plantations by this species is possible only when species of Picea and Larix are present. All the other species can multiply in mass in plantations when either the principal or the intermediate host plant is present. We regard Pinus, Larix, Abies and Pseudotsuga as the principal or primary hosts, and Picea as the intermediate, or secondary host.‡

CONTROL OF GALL-LICE

In view of the special biological features of conifers the loss of the new growth of green assimilating surface not only disrupts the normal growth and development of the trees and reduces their longevity, but can also lead to their rapid death.

Spruce seedlings in nurseries and in areas of reafforestation are killed off when the apical bud is transformed into a gall (we observed this in the Carpathians and in nurseries in Kiev Oblast'); in three to four-year old trees such damage checks the growth, and injury to buds on the lateral branches causes great disfigurement of the crown; young spruces colonized by gall-lice gradually dry up. Young firs shed the needles injured by gall-lice and gradually weaken and die. When gall-lice infest the shoots and needles of young larch, the increase in height is greatly reduced. Young pines are affected in the same way by infestation with gall-lice.

Transformation of the leader buds into galls and the misshapen development and withering of the crown branches in spruce, the drying up of the needles in the whorls and the cessation of growth of the shoots in larch and pine, the destruction of the May shoots in firs, and the increased peeling of the bark in larch are all a direct result of colonization of adult trees by gall-lice. Trees heavily infested with gall-lice are soon colonized by bark beetles. Infestation of trees by gall-lice greatly reduces their ornamental value; weak and dying trees destroy the integrity of the plant composition (in landscape gardening).

The wide distribution of gall-lice in artificial plantations and their great importance in the life of conifers have necessitated the elaboration of control measures against them. With this aim we conducted

‡ The basis for this view is the phylogenesis of Pinaceae, the appearance of sexuparae on Pinus, Larix and Abies, and the anolocycly of the gall-lice on Picea.

phenological observations on the development of the most serious species (Figs. 7 and 8) during 1953-1958. We also investigated the toxicity and phytocidal properties of many insecticides and made some ecological observations.

The characteristic ecological feature of gall-lice is the patchy, even sporadic, nature of their distribution. According to our observations, the causes of the formation of localized centers of population are:* *the limited powers of migration of anolocyclic†† species and heteroecious species, which develop for years by generations of colonists on the same tree; the fairly considerable spatial isolation of artificial plantations and the isolation of the conifers by group and solitaire‡‡planting of deciduous trees in parks; the introduction of gall-lice with planting material, which is then planted out in courtines, groups and solitaires;‡‡ the predilection of the population for the "mother" tree, often so pronounced that microcenters of numerous larvae are formed on the side branches of separate boughs within the crown. "Adherence to one place, manifested in the tendency to return to the scene of development, together with the tendency towards a group mode of life" (Arnol'di [1957]) are very characteristic of gall-lice.

The second typical ecological feature is the love of light of the winged migrants, emigrants and sexuparae. Hence the infestation of the crown decreases from the outside towards the center; in courtines the outside trees are more heavily infested, in avenue plantings the open parts of the crowns are more heavily colonized. The most heavily infested trees are always those growing in well-illuminated dry spots; in shady and low-lying areas of plantations, centers may arise in trees which have already been infested in nurseries. In the conditions of the steppe zone gall-lice centers are more frequent in damp biotopes.

The colonization of the crown of the tree by anolocyclic species steadily proceeds as the tree grows and hence the lower part of the crown is always most heavily infested (decrease in infestation in upward direction). A once initiated center of gall-lice rapidly

---

** Apart from the probable conservatism in distribution, a feature peculiar to species which flourished in previous periods or epochs (in the case of gall-lice – the Upper Cretaceous and Palaeogene).

‡‡"Solitaires" are single trees planted alone; "courtines" are groups consisting of one kind of tree. —Translator.

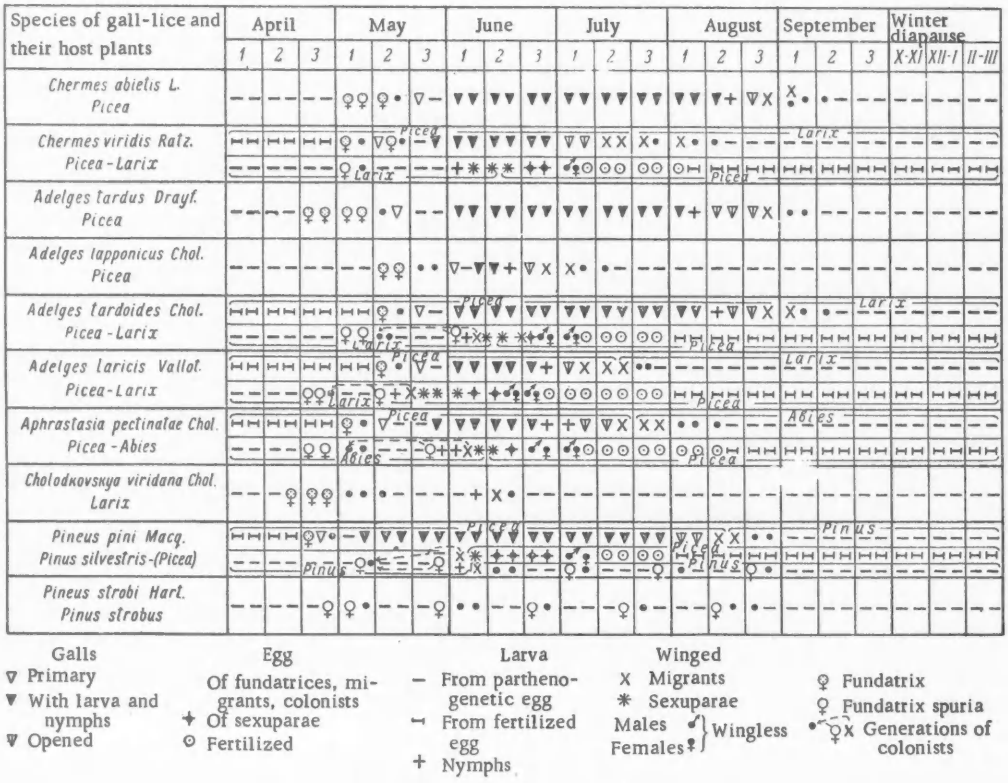


Fig. 7. Life cycle of most important species of gall-lice.

increases in numbers, but enlarges its territory slowly, a very characteristic feature of all anolocyclic species and heteroecious species which multiply over a long period by generations of colonists. These features of the distribution and behavior of gall-lice are important in the organization of their control in artificial plantations.

In the phenology of the gall-lice we must note: 1) the conservatism in the times of development (over a period of six years (1953-1958) the differences in the times of appearance of the developmental stages and the different generations in heteroecious species did not exceed three to five days); 2) the very short period from the start of feeding of the overwintered larva till its transformation into the egg-laying fundatrix which covers itself with abundant waxy down; 3) the extremely short period from the time of hatching of the larvae till their departure into the primary galls (two to three days); 4) the rapid (2-3 days) acquisition of wings by the nymphs after the opening of the chambers in the ripened galls; 5) the very short period from the appearance of the winged migrants and sexuparae till egg-laying (4-5 days); 6) the long period of life in the galls and the short period of development of the individual generations of colonists. All these phenological factors must be taken into consideration in the measures adopted for gall-lice control.

Figure 7 illustrates the phenology of the most important species. It shows the stages of development, the period of concealed life (in the galls) and the alternation of development in heteroecious species. Fig. 8 shows the main species of gall-lice for each genus of Pinaceae; the periods of the separate stages of development and of the concealed life are indicated by a shading system.

The protection of plantations from infestation by gall-lice and the control of the latter in plantations at an early stage of infestation may be fully effective if the following conditions are fulfilled:

1) gall-lice are prevented from colonizing conifers in nurseries;

2) planting material coming from nurseries, culti-

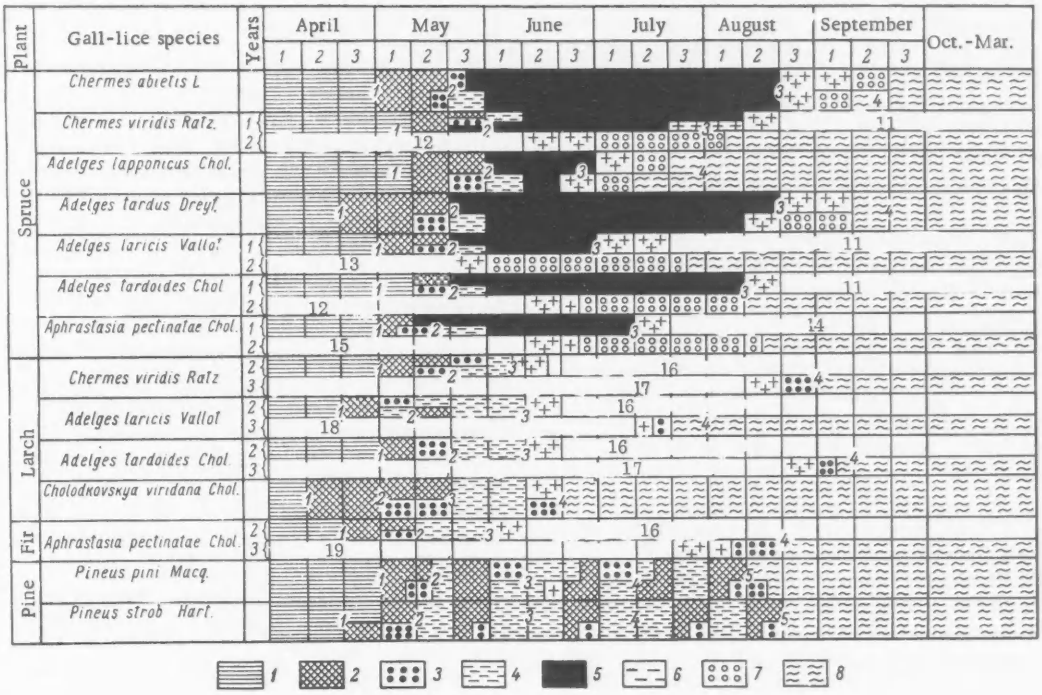


Fig. 8. Phenology of gall-lice on their host plants. 1) overwintered larvae; 2) fundatrices; 3) egg-laying of fundatrices; 4)larvae and nymphs; 5) galls; 6) winged forms; 7) egg-laying of sexuparae and migrants; 8) wintering larvae. The column " Years" indicates the change of host plants in heteroecious species (the names of the host plants are given in the diagram). The figures (1,2,3,4,5) on the diagram for each species indicate the times of application of the insecticides. Key: 11) migration to larch; 12) on larch, on spruce from June; 13) on larch, on spruce in June; 14) migration to fir; 15) on fir, on spruce from June; 16) migration to spruce; 17) on spruce, on larch from August, 18) on spruce, on larch from July; 19) on spruce, on fir from June.

vated forests, and natural woods is subjected to quarantine examination;

3) insecticides are applied (in nurseries and plantations) at times when their toxicity is found to be highest (indicated by figures within Fig. 8);

4) "unripe" galls on young spruces are systematically cut off and destroyed.

We conducted the insecticide trials in the laboratory and the field every year between 1953 and 1959; the field trials were conducted on parts of the crown of the trees and on individual trees; certain courtines were given an over-all treatment (production tests). We tested the toxicity of many insecticides (in different forms and different concentrations) – DDT and BHC preparations, chlorten, chlorphen, thiophos, octamethyl, mercaptophos, "M-74", anabasine and nicotine sulfates, carbolineum (KÉAM), oil emulsions and ISO. The listed poisons were tested on the open-living developmental stages. In the period when the larvae were in the galls octamethyl and mercaptophos were applied. For all the experiments there were control trees or control portions of the crown of the tree. There were two controls: in the case of liquid preparations - spraying with water and no treatment, in the case of dusts – dusting with inert powder (slaked lime, furnace ash) and no treatment. The mortality among the gall-lice was assessed on the 1st, 3rd, and 5th and 7th days. We also compared the infestation and colonization of the experimental and control trees after 20-30 days. Tests of the insecticides were made on the species of gall-lice and all the conifers named in Fig. 8.

From the results of this work we can recommend the following scheme of insecticide application for conifers infested with gall-lice.***

On spruces:

1. Late April – early May. In this period the following applications are effective on overwintered larvae: mineral-oil emulsions – DDT 1.5% and BHC 1.0%; anabasine sulfate 0.3%; mercaptophos 0.1%; octamethyl 0.3%; chlorten 0.7%; soap-oil emulsion 0.5% (by oil).

2. From approximately May 20-May 30. In this period the destruction of the bulk of the larvae emerging from eggs laid by the fundatrices is possible if the chemicals are applied as soon as the larvae start to hatch out. The best results in our experiments were given by: mineral-oil emulsions of DDT and BHC (in the same concentration as in the first period), or mixtures of them (DDT 1.0% + BHC 0.5%); thiophos 0.15%; a 1% suspension of 30% DDT dust.

The spraying of spruces in the 1st and 2nd periods should be similar to the application of early spring washes to fruit trees.

3. "Ripening" of galls and appearance of first winged forms (on Fig. 8 – period 3). The application of DDT (5.5%) or BHC (12%) dusts, or, even better, a mixture of them (2:1), in this period can destroy the bulk of the egg laying fundatrices both of anolocyclic and heteroecious species. Good results were obtained in experiments where a 1% suspension of 30% DDT dust, or a 1.5% emulsion of DDT and BHC was used in this period.

4. Appearance of wintering larvae (period 4 on Fig. 8). These must be exterminated in the second third of September by the application of DDT and BHC dusts (a 2:1 or 1:1 mixture of them) or thorough spraying with 1.5% emulsions of the same insecticides or a 0.5% suspension of 30% DDT dust.

On larches:

1. Application of mineral-oil emulsions (DDT 1.5% and BHC 1.5%) in period 1 (Fig. 8) destroy the wintering larvae of Chermes and Adelges and the hatching larvae of A. laricis.

2. In the second period (from about May 20) the application of DDT and BHC mineral-oil emulsions, anabasine and nicotine sulfate (0.2% and 0.15%) or 12% BHC dust is effective. All these preparations exterminate larvae which are hatching out or have hatched out.

3. In the period of appearance of winged sexuparae in the first third of June (period 3) dusting with a mixture of DDT and BHC dusts (2:1) is essential; this period is very short and dusting must be commenced soon as the first nymphs are discovered (Fig. 7).

4. In the fourth period the wintering larvae of the first three species (Fig. 8) are destroyed; DDT (2.0%) and BHC (1.5%) emulsions, DDT and BHC dusts, or a 0.5% suspension of 30% DDT dust are effective in this period.

In plantations where the green larch chermes occurs the following measures should be taken: About April 10 – careful spraying of trunks, boughs and side branches using 1% DDT emulsion with 0.5% BHC emulsion concentrate added; in late April and early May – the same preparations or a 0.1% solution of mercaptophos or thiophos with the addition of 0.5% of 30% DDT dust to one of these solutions; about May 20 – the same preparations; in the last third of June – the same, or anabasine sulfate 0.2%.

On firs:

1. At the end of the second third of April the overwintered larvae can be effectively destroyed by DDT or BHC emulsions, 12% BHC dust or a 0.5% suspension of 30% DDT dust.

2. At the start of the second third of May the following give good results against hatching larvae: DDT and BHC emulsions, anabasine sulfate 0.2%, a 1% suspension of 30% DDT dust, and DDT (5.5%) or BHC (12%) dusts.

3. On the appearance of the nymphs in late May

***The concentrations in each case refer to the preparation produced by our native chemical industry.

(Figs. 7, 8) a mixture of DDT and BHC (2:1) dusts should be used.

4. In the last third of August all the preparations which we recommended for period 4 in the case of spruces are effective against wintering larvae.

On pines:

1. In the last third of April the overwintered larvae (on the bark of the trunk, boughs and side branches) can be effectively destroyed by the application of 1.5% DDT or BHC emulsions, mercaptophos 0.5%, anabasine sulfate 0.3%, nicotine sulfate 0.2%, or 12% BHC dust on the Scotch pine; and 2% BHC emulsion, or mercaptophos 1% on the Weymouth pine.

2. In the second third of May, when the larvae are hatching, the application of insecticides is particularly important. Effective treatments for this are: On Weymouth pine – 2% emulsions of DDT and BHC, a 1% suspension of 30% DDT dust, a mixture of 5.5% DDT dust and 12% BHC dust (2:1); on Scotch pine-1.5% DDT emulsion, 1% BHC, or 1% DDT plus 0.5% BHC, anabasine sulfate 0.2%, or mercaptophos 0.2%.

3. In the third and fourth periods (Fig. 8) the application of chemical poisons is required only if they have not been applied at the appropriate times (hatching of larvae) in the second or third periods.

4. At the end of the second third of August the application of chemicals is very important, since it greatly reduces the numbers of wintering larvae. At this time (Fig. 8, period 5) the same preparations are applied as in the second third of May.

In 1956 and 1957 we made a study of systemic insecticides with the aim of destroying the larvae in the galls. In 1956 the only effective treatment was a 1.5% solution of 30% mercaptophos concentrate. This killed off all the larvae in the galls within five days of spray application to young spruces at a time when the galls were fully formed. In 1957 systemic insecticides were applied in the period of development of the fundatrices, when primary gall formation ††† was just beginning. In these experiments the best results were given by mercaptophos (0.1 and 0.15%); on trees treated with this preparation there were no galls. Octamethyl (0.1, 0.2, 0.3%) gave rather poorer results, since a few galls were formed on the trees and the larvae inside them were still alive. On trees treated with the preparation "M-74" the larvae were killed in the primary galls, but a few galls containing living larvae were still formed. Thiophos (0.1%) halved the number of the galls (as compared with the control), but the infestation was still very high.

SUMMARY

The paper presents the results of studies on the species of plant-lice (Phylloxeridae, Chermesinae) in the Ukrainian SSR; the author has found 17 species of Chermesinae within this territory. Besides the species ascertained for the European part of the USSR (Shaposhnikov, 1955) there have been found Dreyfusia piceae Ratz., Aphrastasia sp. (on Pseudotsuga taxifolia) and Cholodkovskya viridula Chol. The list of conifers (fam. Pinaceae) inhabited and injured by Chermesinae in park and other artificial plantations of the Ukraine is enclosed. Brief characteristics of the injuries caused by the main species of Chermesinae, certain features of their ecology, phenology of the most important species (Figs. 7 and 8) are given. Chemical methods of the control of Chermesinae on fir trees, larches, silver fir trees and pines, devised by the author, are recommended. The author, taking into account the strong evolutionary relationship of Chermesinae with the fam. Pinaceae (Table 1) and food links of modern species of Chermesinae arranges them into six biological groups: such division is of great practical importance in the prognosis of Chermesin fauna of any concrete plantation.

LITERATURE CITED

K. V. Arnol'di, "On the theory of range in relation to the ecology and origin of species populations," Zoolog. Zhur. 36, 11, 1609-1628 (1957).

G. V. Dmitriev, "Gall-lice in parks in the Ukraine," Abstracts of Reports to the Scientific Conference on Plant Protection, Academy of Sciences of the Lithuanian SSR [in Russian] (1958) pp. 37-39.

G. V. Dmitriev, "Injurious insects and mites in park plantations of the Ukraine," Zool. Zhur. 38, 6, 846-859 (1959).

V. V. Dobrovlyanskii, Report on the Work of the Entomological Section of the Kiev Plant Pest Control Station of the South Russian Society for the Encouragement of Agriculture for the Year 1914 [in Russian] (1915).

I. I. Klodnitskii, "Study of plant-lice in the Ukraine," Kiivs'ki naukovi vistic, 15-26 (1921).

A. L. Lypa, "The dendrological riches of the Ukrainian SSR and their utilization," Tree and Shrub Planting in Populated Centers [in Russian] (Izd. Akad. Arkhit. AN Ukr. SSR 1952) pp. 11-521.

V. A. Mamontova, Dendrophilous Plant Lice of the Ukraine [in Russian] (Izd. AN Ukr. SSR 956) pp. 1-90.

A. K. Mordvilko, "Evolution of cycles and the origin of heteroecy in plant-lice," Zashch. Rast. ot Vredit. 7, 1-9 (1925).

A. K. Mordvilko, "Food plants of plant-lice of the USSR and neighboring countries," Tr. po Priklad. Éntom. GIOA 14, 1-100 (1929).

A. K. Mordvilko, "Speciation in plant-lice," Éntom. Obozr. 25, 1-2, 7-39 (1933).

A. K. Mordvilko, "Plant-lice: their cycles of generations and their evolution," Priorda 11, 34-44 (1935).

---

†††By primary galls we mean galls caused by the sucking of the fundatrices (Fig. 3).

A. K. Mordvilko, "Suborder Aphidodea – Plant-lice," Key to Insects of the European USSR [in Russian] (1948) pp. 187-226.

E. N. Pavlovskii, "Conditions and factors in the formation of the parasite organism by the host in the process of evolution," Zool. Zhur. 25, 4, 289-304 (1946).

N. N. Padii, Author's abstract of candidate's dissertation: Larch Pests in Plantations in the Ukr. SSR and Their Control [in Russian] (1953) pp. 3-14.

V. B. Pospelov, Report of the Work of the Entomological Station of the South Russian Society for Encouragement of Agriculture for the Year 1908 [in Russian] (1909).

I. A. Rubtsov, "Phylogenetic parallelism of parasites and hosts and its significance in systematics and geography," Uspekhi Sovremmenoi Biol. 13, 3, 430-456 (1940).

V. N. Stark, Injurious Forest Insects [in Russian] (1931) pp. 1-456.

V. N. Stark, "Short review of tree pests in the forest zone," Animal World of the USSR [in Russian] (1953) Vol. IV, pp. 631-650.

N. A. Kholodkovskii, "On biological species," Izv. Akad. Nauk St. Petersburg, 4, 10,751-770 (1910).

N. A. Kholodkovskii, Gall-lice Injurious to Conifers [in Russian] (1915), pp. 1-90.

N. A. Kholodkovskii, Biological Essays [in Russian] (1923) pp. 257-273.

N. A. Kholodkovskii, Course in Entomology [in Russian] (1929) Vol. 2, pp. 132-197.

G. Kh. Shaposhnikov, "Suborder Aphidodea – Plant-lice," Key to Insects Injurious to Shelterbelt Trees and Shrubs [in Russian] (Izd. AN SSSR, 1950) pp. 49-75.

G. Kh. Shaposhnikov, "Evolution of Certain groups of Aphids in Association with the evolution of Rosaceae," The N. A. Kholodkovskii Memorial Lectures for 1950 [in Russian] (1951) pp. 28-60.

G. Kh. Shaposhnikov, "Suborder Aphidodea – Plant-lice," Forest Pests (A Reference Manual) [in Russian] (1955) Vol. 2, 782-845.

G. Kh. Shaposhnikov, "Phylogenetic basis for a classification of short-tailed aphids with reference to their relations with plants," Tr. Zool. Inst. AN SSSR 23, 215-320 (1956).

A. V. Yatsentkovskii, Principal Insect Pests in Forests of the USSR [in Russian] (Sel'khozgiz, Moscow-Leningrad, 1931).

C. Börner, Die Blattläuse Mitteleuropas (Europae centralis Aphides). Mitteil. Thüring. Botan., Geselsch., Beiheft 3, 1-488 (1952).

L. Reh, and P. Sorauer, Handbuch der Pflanzenkrankheiten, 2, 675-695 (1932).

WEEVILS (Coleoptera, Curculionidae) AS TIMBER PESTS IN HOUSES AND STRUCTURAL TIMBERWORK

V. Ya. Parfent'ev

Translated from Entomologicheskoe Obozrenie, Vol. 39, No. 3, pp. 545-550
July-September, 1960

Among the weevils which damage timber in engineering structures and houses the most important economically are the following species: Pselactus spadix Hrbst., Rhyncolus culinaris Germ., and Mezites pallidipennis Boh.

Secondary pests, of less economic significance, are Cossonus linearis F., Cossonus parallelepipedus Hrbst., and Eremotus porcatus Germ.

P. spadix and R. culinaris mainly attack timber in houses, while M. pallidipennis attacks piles, gangways and other timberwork on Black Sea wharves in Sevastopol and Yalta. The Cossonus spp. and E. porcatus destroy half-rotting timber in industrial buildings and structures.

In the special literature, which is rather scanty, there are accounts of the injurious activity and of some aspects of the biology of P. spadix and R. culinaris. As regards the other species, M. pallidipennis in particular, there is actually no information at all.

1. Pselactus spadix Hrbst.

This weevil (Figs. 1, 2, 3) mainly damages timber from coniferous trees (pine, spruce); its ravages are fairly frequently encountered in houses in Leningrad and the coastal towns of the Crimea. It is found much more rarely in untenanted, unheated houses, and mainly in the south. In basement floors it is fairly frequently accompanied by larvae of Nacerda melanura L.

P. spadix attacks beams in the cellar ceiling. We gave an account earlier of the nature of the occurrence of this weevil and the conditions in which it grows (Parf'entev [1936]). The infestation of attic flooring by P. spadix is very rarely encountered, and here it is usually replaced by the other weevil – R. culinaris. Fresh and old timber stacked in the open is not infested by P. spadix owing to the relatively low humidity. It requires a substrate humidity of at least 35%. According to our observations in Leningrad in 1934, old timber in houses in its second to third year of service was subject to attack by this weevil. Reikhardt et al. [1930] and Shestakov [1933] describe it as a pest in houses.

The damage caused by this weevil is very characteristic (Fig. 3). Heavily infested timber has the appearance of fine-pored sponge, is dark in color, and sometimes shows obvious signs of decay. The upper and lower surface layers of damaged timber are completely destroyed by this pest.

The beetles can live for two years. In Sevastopol in winter we found wintering larvae and adults of this pest. The weevil becomes active fairly early in spring in March. In April-May the adult females lay their small semitransparent eggs in small batches of two to nine in old galleries and cracks in the timber. Beetles of this species are found the whole year round. They do not fly, and the centers of this pest extend and spread

Fig. 1. Pselactus spadix Hrbst.

Fig. 2. Larva of Pselactus spadix Hrbst.

from flat to flat by the delivery of infested firewood and by the crawling of beetles from one house to another.

2. Rhyncolus culinaris Germ.

This weevil (Figs. 4, 5) damages timber of coniferous and deciduous trees. In Sevastopol and Simferopol we found it in the structural timberwork of houses – in window frames (outer parts), in the open ends of joists, in wall plates, and in the ends of rafters kept damp by periodic rain or snow.

In untenanted buildings it attacks joists, pillars, struts, ground flooring and other exposed parts of the timberwork. This weevil does not occur inside houses, or in oil-treated timber. The specialist literature contains reports of it damaging timberwork in mines, props, etc., the horizontal logs in timber houses (outside), and dry parts of trees, mainly deciduous ones (Shestakov [1933], and others).

Our observations in the Volga Region (1936) and in the Crimea (in 1940) established that colonies of this beetle are associated with old but healthy timber which has been in service for many years. These colonies are of a focalized, compact character. The damage it causes is very similar to that caused by P. spadix but the larval tunnels and the cavities formed by them are smaller, and the damaged timber has a more or less normal color and does not turn brown as in the case of attack by P. spadix. The humidity of the timber which it attacks is much lower than is the case with P. spadix and lies between 14 and 26%.

The weevil winters in the adult and pupal phases. It becomes active fairly early – in March in the south. We observed pairing and egg-laying in May. This beetle, like P. spadix, occurs the whole year round. In autumn (October) we found live beetles and larvae of various, mainly older, stages.

3. Mezites pallidipennis Boh.

This is the largest (Fig. 6) of all the weevils which we found attacking timber of coniferous trees (pine and spruce). The females attain a length of 6-7 mm and are black in color with dark brown elytra; the elytra and pronotum are shiny and are covered with coarse punctures, which form regular series on the elytra. The rostrum in the female is more slender than in the male, and the latter is smaller in size – 4.5-6 mm. The male elytra are pale chestnut and are also covered with regular series of punctures.

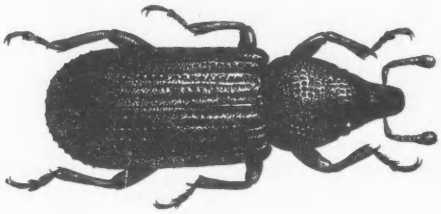


Fig. 4. Rhyncolus culinaris Germ.

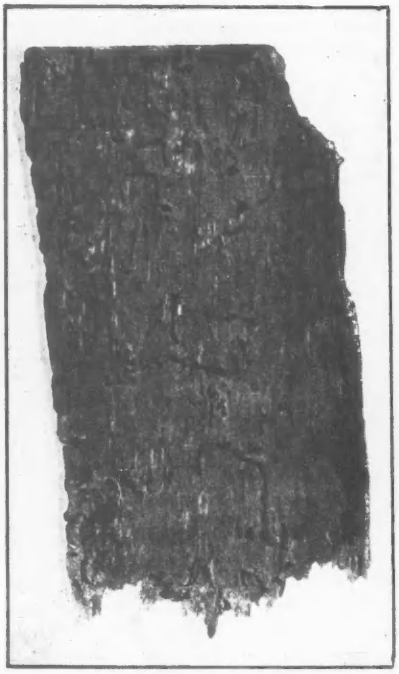


Fig. 3. Damage caused by P. spadix.

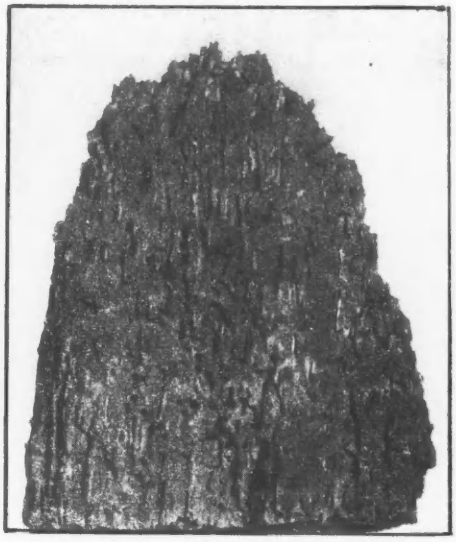


Fig. 5. Damage inflicted by R. culinaris.

The larva is milky white and has a well-developed front pair of legs. It is 5-8 mm long.

In Sevastopol we found this pest in old, rotting timber periodically wetted by sea water. Damage inflicted by it was found in beams, pillars, braces and piles of piers, in shore timberwork (stanchions), and so on. In certain parts of the logwork and pillars we found up to 50 larvae per 1 dm^{2}* (Fig. 7). Timberwork heavily attacked by this weevil soon fell into disrepair and was completely destroyed.

The literature contains no information on the biology of M. pallidipennis. F. K. Luk'yanovich found it on the Caspian coast. Perris (according to Luk'yanovich) reports the finding of this species in timber cast up by the sea in Corsica.

On cutting open damaged timberwork we found that the development of the larva took place in the deep layers of the sapwood. Only the round exit holes could be seen on the surface of the wood. The larval tunnels were fairly numerous and close together. They extended in various directions and were always packed with moist bluish gray frass. The damaged timber was mostly dark bluish, with occasional reddish patches. In late June the beetles become active, mate, and appear on the surface of the infested timber.

4. Cossonus linearis F.

We found this weevil in half-rotten poplar stumps and half-rotting pine timber in old wooden erections, in structures and pillars sunk in the ground, in the parts under the ground or close to it. In all cases the wood infested by the weevil was rotting and was easily destroyed. In trunks of deciduous trees, in rotting poplar and occasionally pine timber, this species was accompanied by Cossonus parallelepipedus Hrbst. Both species of Cossonus are adapted for life in rotten timber of deciduous trees, mainly willow and poplar.

5. Eremotus porcatus Germ.

This beetle damages the timber of conifers (pine, spruce) and we found it in structural timberwork, and in rotting telegraph and telephone poles in several large towns in the Crimea and the south of the USSR. It does not occur in houses. Its colonies are of a focal nature.

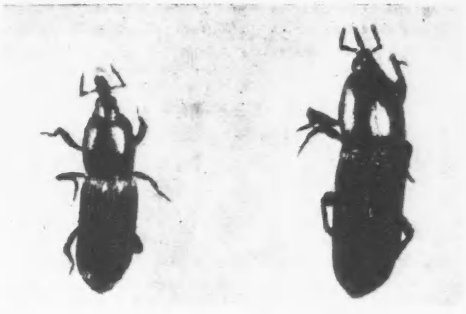


Fig. 6. Mezites pallidipennis Boh.

As distinct from P. spadix and R. culinaris this species does not destroy the outer parts of the timber, and the exit holes of the beetles usually open into cracks. With damage of this type it is difficult to discover the colonies of this weevil. The larval tunnels are short, intertwined, and often packed with brown frass. We noted that this species became active in April-May. In places where this pest occurred we found beetles crawling over the damaged timber in the evening in May-June.

CONTROL OF TIMBER WEEVILS

For control of the house weevils (P. spadix and R. culinaris) the following measures are necessary in addition to the preventive measures recommended in the rules for the care of houses and office buildings:

1. In major repairs timber impregnated with technical creosote or other antiseptics based on creosote, or soaked in 20% mineral-oil emulsion (copper sulfate emulsifier) of BHC with 20% oil and 2.5% BHC to the volume of the base liquid, should be used for joists and all the attic timberwork.

2. The timberwork of upper-floor should be dusted with 12% DDT dust, 100 g per 1 sq. m, or sprayed with a solution of 60 g DDT in 1 liter of water. Heavily infested portions must be removed and burned immediately.

3. In routine repairs on buildings the same measures should be taken as in major repairs, but they may be restricted to one spraying or dusting of the new and remaining old parts of floors, walls etc.

4. For control of P. spadix the cellar ceiling should be well ventilated in the spring-summer period to dry out the timber.

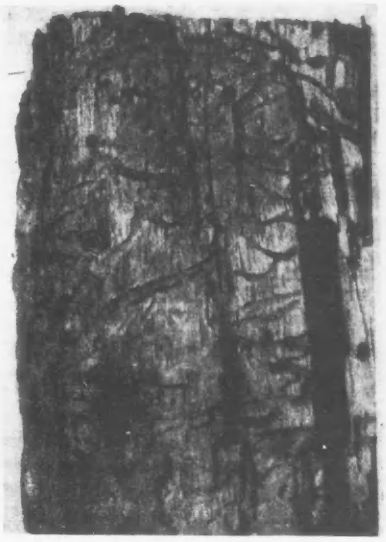


Fig. 7. Damage inflicted by M. pallidipennis.

* As in original - Publisher's note

LITERATURE CITED

V. Ya. Parfent'ev, "New data on the timber destroyers Pselactus spadix Hrbst. and Rhyncolus culinaris Germ.," Zashch. Rast. 8, 171-174 (1936).

V. Ya. Parfent'ev, "Rhyncolus culinaris Germ. in the Volga Region," Zashch. Rast. 17 (1938).

A. N. Reikhardt, B. P. Karakulin and V. B. Isaichenko, Timber Destroyers and Their Control [in Russian] (Moscow, 1930) pp. 1-58.

V. N. Stark, "Laboratory observations on Pselactus spadix Hrbst." Zashch. Rast. 14, 107-109 (1937).

A. V. Shestakov, Timber Pests [in Russian] (Moscow, 1933) pp. 1-244.

ON FRUIT-MOTHS (MICROLEPIDOPTERA) AND THEIR PARASITES IN THE MARITIME TERRITORY

L. S. Sytenko

All-Union Institute for Plant Protection, Leningrad

Translated from Entomologicheskoe Obozrenie, Vol. 39, No. 3, pp. 551-555, July-September, 1960

Fruit moths which are important pests in orchards, have a widespread distribution in the Soviet Union. In European USSR, the following species of fruit-moth are found: Laspeyresia pomenella L., the common apple fruit moth,* L. funbrana, the plum fruit moth, and L. pyrivora, Dan, the pear fruit moth.

Engelhardt [1928] has described the damage done by fruit-moths to the fruit growing industry of Ussuri Land†. He points out that in the Vladivostok Region, Grapholitha funebrana Tr. damages as much as 80% of the plum crop. Mishchenko [1949] regarded this species as being the same as Gr. molesta Busck. and gave certain details of its biology and phenology. In 1953, Kozhanchikov described this same fruit-moth as a new species, naming it the cherry fruit-moth, Gr. cerasana Kozh.

So far, the only fruit-moths believed to bring about damage to orchards in the Far Eastern Territories of the USSR are representatives of the genus Laspeyresia. However, Zemlina [1954] has shown that in Ussuri Land Carposina sasakii Mats. attacks the pear and Tikhonov [1956], has noted that the same species is a serious pest to the apple growers of southern Ussuri Land.

The object of our investigations was 1) to describe the whole complex of fruit-moth species attacking both bush and tree fruits in Ussuri Land; 2) to determine which particular species of parasite attacked each host species of fruit-moth and how effective these parasites were in controlling the numbers of the host.

A study of fruit-moth species and their parasites formed part of the dissertation completed by the author under the guidance and direction of V. A. Shchepetil'nikova. This study was carried out mainly in the Slavyansk, Suchansk, Shkotovsk, Partizansk and Chernigovsk Regions of Ussuri Land, while the experimental work was conducted at the Far-Eastern Republic's Plant Protection Station.

The author is indebted to I. V. Kozhanchikov for the identification of the fruit-moths, to E. Ya. Ozols for the identification of parasites belonging to the family Ichneumonidae and to V. I. Tobias for the identification of parasites belonging to the family Braconidae.

SPECIES OF FRUIT-MOTHS

As a result of our investigations, the following species of fruit-moth have been shown to occur in Ussuri Land: Grapholitha funebrana Tr. – the plum fruit-moth; Tmetocera prognathana Snell. – the white apple-tree fruit-moth; Carposina sasakii Mats. – the peach fruit-moth; Laspeyresia sp. and Argyresthia conjugella Zell. – the mountain ash fruit-moth.

Graptolitha funebrana Tr., THE PLUM FRUIT-MOTH

Gr. Funebrana Tr. attacks plum trees of the species Prunus triflora and cherry trees Cerasus japonica, wherever these two species are cultivated in Ussuri Land. In the course of a year, there are two generations of the pest on the plum trees but only one on the cherry trees. Larvae of the first generation (June-July) do most damage to the plum trees, and together with those of the second generation (July-August), they may destroy 40-90% of the fruit crop. The first generation caterpillars feed on the soft, unformed endocarp of the plum, which as a result of their attack only attains the size of a ripe wild strawberry. The caterpillars of the second generation feed on the flesh of the fruit and do not penetrate into the kernel which at this time is covered with a hard shell. Plums damaged by the caterpillars assume a characteristic violet tint. The place where the larva has penetrated the fruit may be readily recognized by the drop of gum, which oozing from the spot, solidifies into a transparent bead.

The cherries which have been damaged by fruit-moth larvae are mishapen and redden earlier than normal fruit.

The spring flight of this species of fruit-moth takes place in June, to be followed by a second generation in summer – from the second half of July to the middle of August. Some of the first generation larvae (9-25%) undergo diapause and do not pupate until the following spring. The flight of the moths emerging from these pupae has been observed in early summer (June) contemporary with that of the normal spring brood. The first and second broods of this fruit-moth merge into one another, so that it is difficult to say where one ends and the other begins.

During out determination of the identity of this species, we took living material and subjected it initially to low temperatures (from + 10° to −19°C), periodically humidifying it. The material was then transferred to a thermostatically controlled incubator at a temperature of 20-24°. This was done on four separate occasions: The first occasion was on February 4th, the second on

* This pest is known in the U.S. as the codling moth. – translator.

† "Ussuri Land" is the English translation of the title included in the original Russian article. It is a translation of "Primorskii Krai," which is better translated as the "Maritime Territory." – Publisher's note.

February 12th, the third on February 22nd and the fourth on March 18th, 1958. The time of emergence of the moths in each separate experiment is given below.

Material placed in the incubator on February 12th gave adult Gr. funebrana from March 10-16th; that placed in the incubator on February 22nd – from March 17-27th, whereas that placed in the incubator on March 18th produced imagos between April 1st and 12th.

Larvae of the fruit-moths which attack plums and cherries overwinter in the soil, where at a depth of 5-10 cm they construct elongate, silky cocoons, to the surface of which are glued soil particles.

The Far Eastern form of the plum fruit-moth Gr. funebrana Tr. has certain biological characteristics, which distinguish it from the European Gr. funebrana Tr. One of the peculiarities of the former is its ability to attack cherries as well as plums. Furthermore, first generation larvae of the Far Eastern form feed on the endocarp of the fruit, and this form overwinters as a pronymphal stage in the soil. It is well known that the European form of the plum fruit-moth overwinters under the bark of trees [Mashkovich 1930; Bagdavadze, 1941; Popova, 1956] and it has never been shown to feed on the endocarp of the plum.

Tmetocera prognathana Snell., THE WHITE APPLE FRUIT-MOTH

This species of fruit-moth – which is endemic to the Far Eastern Region — attacks cultivated apple trees, Malus domestica, also the wild crabapple, Malus Manshurica and the hawthorn, Crataegus maximowiczii. The white apple fruit-moth has been found in the Slavyansk, Chernigovsk, Partizansk, Sychansk and Shkotovsk Districts of Ussuri Land.

This fruit - moth does considerable damage (77-85%) to the following varieties of apple: – Alebastrovyi, Siberian Beauty, Vargul' Russet, Anis White; slight damage is done to the following varieties: Chinese Shafran, Chinese Bellefleure, Slavyansk and Peping Shafran. The larvae of the Tmetocera prognathana feed mainly on the flesh of the apple, making sinuous tunnels through it. Older larvae are to be found within the fruit, but immediately underneath the calyx so that externally their position is marked by a worm-hole plugged with excrement and silken webbing. By poking into the worm-hole it is possible to extract the caterpillar.

Fruits of wild crab apple and hawthorn attacked by this species are usually fastened together in groups of three or four by the mass of silken webbing and excrement produced by the larvae. Each fruit in such a group is found to contain a single caterpillar which feeds on the fleshy part of the fruit. If the whole pericarp of one fruit is eaten away, then the larva moves on to the next. The maximum damage is done during July and early August. The species overwinters in the pronymphal stage under the bark of trees and in litter, where white, elongate cocoons are produced. Material transferred to a thermostatically controlled incubator on the fourth of February gave rise to imagos from the 12th to the 21st of the same month, except for one moth which did not emerge until March 16th; material placed in the incubator on February 22nd yielded imagos from the 17th-19th of March.

Carposina sasakii Mats, THE PEACH FRUIT-MOTH

The peach fruit-moth which is endemic to the Far Eastern Region – attacks cultivated apple trees Malus domestica, the hawthorn Crataegus maximowiczii, the pear Pyrus ussuriensis and the apricot Armeniaca manshurica. This species of fruit-moth is found in all parts of Ussuri Land where Tmetocera prognathana occurs. It is found that 80-100% of the fruit in these areas is attacked. The larvae feed both on the flesh and also on the seeds of the fruits they attack. The maximum damage is done during July and August and towards the end of the latter month the caterpillars construct for themselves cocoons in the soil at a depth of 5-10 cm, where they spend the winter. The cocoons resemble small pellets and the larvae lie curled up inside them. The inner surface of the cocoon is lined with silk and its outer surface is dotted with fine particles of soil. Cocoons placed in the incubator on February 4th yielded imagos between March 27th and April 3rd; those placed in an incubator on February 22nd yielded imagos between March 18th and April 14th.

Carposina sasakii Mats and Tmetocera prognathana Snell. are both found as pests on cultivated apple trees; they may be readily distinguished, however, by the structure of the cocoons in which the caterpillars overwinter and by their different hibernating places.

Laspeyresia sp. A NEW, UNDESCRIBED SPECIES

The author has found this fruit-moth as a larva attacking rose-hips (fruits of Rosa canina); in Ussuri Land it is rare and its attack seems to be restricted to rose-hips.

Argyresthia conjugella Zell. THE MOUNTAIN-ASH MOTH

Damage to fruit by Argyresthia conjugella is not uncommon but is always ascribed to the previously mentioned species of fruit-moth. This moth has been found attacking fruit in Rennet apple orchards and also semi-cultivated varieties of apples in the Slavyansk, Chernigovsk, Partizansk, Suchansk and Shkotovsk Districts of Ussuri Land. It also attacks wild crab-apples in the Chernigovsk District. The larvae bore tunnels through the flesh of the apple to the seed box and then feed on the apple pips until nothing is left but their testae. The attack is most intense in July and August. During the third 10 day period of August the larvae construct silken cocoons for themselves under the bark of the tree. These silken cocoons have a double wall. Initially the larva spins an azure-blue cocoon in which it lies

freely. After several days in the azure cocoon a dense, white cocoon is made, which is clearly visible through the azure silk. The larvae pupate within the cocoons at the beginning of September and spend the winter in the pupal stage.

Material kept at a high temperature from February 12th, produced imagos between March 6th and 24th; that placed in an incubator on February 22nd yielded imagos between March 21st and April 7th.

We have, therefore, been able to show that in Ussuri Land there are several different species of fruit-moth involved in the damaging of fruit trees. In view of the considerable amount of damage done by these species and the risk of their spreading to other parts of the Soviet Union, changes in the present quarantine regulations are needed to limit fruit-moths and prevent their spread.

PARASITES OF FRUIT-MOTHS

Until the author investigated this problem, no entomophagous species attacking fruit-moths had been recorded for Ussuri Land. The following species of Brachonid and Ichneumonid parasites have been found destroying fruit-moths of the species Grapholitha funebrana Tr., Tmetocera prognathana Snell. and Carposina sasakii Mats. in the course of the present researches. All the species listed belong to the family Braconidae, except Epiurus brunnea, which belongs to Ichneumonidae. From Graphalitha funebrana Tr.:

1. Apanteles sarcitorius Tel.
2) A. xantostigma Hal.
3) A. lacteicolor Vier.
4) Bracon variator Nees
5) Braunsia sp.
6) Phanerotoma dentata Panz.
7) Epiurus brunnea Brischke

From Tmetocera proganthana Snell.:

1) Apanteles xanthostigma Hal.
2) A. parasitellae Bouche
3) Chelonella sp.

From Carposina sasakii Mats.:

1) Bracon variator Nees
2) Chelonella sulcata Jur.
3) Chelonella sp.

Among the Braconid parasites are two undescribed species: Braunsia sp. and Chelonella sp., moreover Epiurus brunnea Brischke has not hitherto been recorded for the Soviet Union.

All the fruit-moth parasites listed above are new records for Ussuri Land.

Although several different species have been shown to parisitize fruit-moths in Ussuri Land, it is not known how effective they are in controlling the populations of their host. The level of parasitization among fruit-moths does not exceed 4-12%. It would appear, therefore, that in the Far East parasites have little importance in reducing the numbers of these pests. As a result, the fruit-moths can multiply freely and in consequence do an enormous amount of damage.

The author is deeply indebted to V. A. Shchepetil'nikova for her constant help and collaboration and to I. V. Kochzhikov, E. Ya. Ozols and V. I. Tobias for their assistance in identifying material.

LITERATURE CITED

A. I. Bagravadze, "The biology and ecology of the Plum Fruit-Moth (Laspeyresia funebrana Tr.) and methods of controlling it," Izv. Gruz. Opyt. Stan. Zashch. Rast., series B (Entomology) 2, 74-82 (1941).

A. S. Danilevskii, "On the specific identity of fruit-moths (Lepidoptera, Pyralidae, Carposinidae, Tortricidae), attacking orchards in the Far Eastern Region," Éntom. Obozr. 37, 2, 282-293 (1958).

A. G. Zemlina, "The most important pests of fruit-culture in Ussuri Land and methods of controlling them," AN SSR, Dal'nevost. fil. im. V. L. Komarova, Vladivostok, 1-16 (1954).

I. V. Kozhanchikov, "Two new species of fruit-moth belonging to the genus Laspeyresia (Grapholitha), which attack fruits of cultivated Rosaceae in Eastern Siberia," Éntom. Obozr. 33, 109-122 (1953).

L. A. Mashkovich, "On the biology of the Plum Fruit-Moth Laspeyresia (Grapholitha funebrana Tr. under conditions prevailing in the Sochinsk district," Izv. Severokavkazsk. Stan. Zashch. Rast., 6-7, 63-76 (1930).

A. I. Mishchenko, "Pests of soft fruit and methods of controlling them," Kh. Plodovoyagodnyi sad na Dal'nem Vostoke. Dal'giz. Khabarovsk: 207-272 (1949).

A. I. Popova, "The Plum Fruit-Moth in the Black Sea Littoral of Krasnodarsk," kh. Zashchita Plodovykh Kull'tur i Vinograda ot Vreditelei i Boleznei M: 36-45 (1956).

N. P. Tikhinov, "The Peach Fruit-Moth" Zashch. Rast ot Vred. i Bolezn." 4, 43-44 (1956).

V. M. Engel'gardt, "A list of agricultural pests in the Far Eastern Region," Zashch. rast. 5, 1: 50-56 (1928).

GONOTROPHIC CYCLE IN PHYTOPHAGOUS SPECIES OF BLACK-FLIES (DIPTERA, SIMULIIDAE)

I. A. Rubtsov

Zoological Institute, Academy of Sciences, USSR, Leningrad
Translated from Entomologicheskoe Obozrenie, Vol. 39, No. 3, pp. 556-573, July-September, 1960

INTRODUCTION

Besides its general biological interest, the study of the gonotrophic cycle in phytophagous species of black-flies is important from the viewpoint of method. It contributes to an understanding of the gonotrophic cycle in bloodsucking species, especially in facultative bloodsuckers, which constitute the majority of black-fly species. Facultative bloodsucking results in marked fluctuations in the attacking activity of the female flies. Facultative bloodsucking, so characteristic of black-flies (Rubtsov [1955]), as we are now beginning to find out (Glukhova [1956]; Amosova [1956]), is apparently not a rare feature in the Heleidae (where the majority of species are phytophagous). It has been reported also in the case of the Culicidae (Dolmatova [1946]; Enikolopov [1950]) and Tabanidae (Olsuf'ev [1940]), and is probably a feature of all the other families of bloodsucking dipterans. The great variety of types of supplementary feeding, some of which are manifested in the facultative nature of bloodsucking, and the associated various types of gonotrophic cycle may be more easily and better understood against a background of knowledge of the more primitive (in evolutionary aspect) development of the sexual products in phytophagous species.

A few years ago there appeared a paper by Davies and Peterson [1956] with notes on the gonotrophic cycle in phytophagous North American species (Cnephia dacotensis D. and Sh., C. eremites Shew., Gymnopais holopticus Stone and G. dichopticus Stone). These authors, however, did not examine the development and changes in the fat body in relation to the maturation of the ovaries. Our work is devoted mainly to this subject. Prokof'eva [1959] published a paper, which she completed under my guidance, on the gonotrophic cycle in phytophagous black-flies, but her paper did not touch at all on many of the questions with which I deal. The lack of agreement between my results (on the rates of ovarian development and fecundity) and those of Prokov'eva I am inclined to attribute not to errors of observation on either side, but to the extreme variability of the gonotrophic cycle in relation to feeding conditions, temperature, etc., which, of course, vary in different years. My observations were made in 1952-1953, and those of Prokof'eva, in 1955-1956. The information on the gonotrophic cycle in the most thoroughly investigated mosquitoes is of very great value for an understanding of the questions under consideration. Autogenous forms of bloodsucking species have been produced experimentally. The rearing of one of the forms of the bloodsucking Culex tarsalis Coq. on media rich in nutrient substances gave autogenously developing females; when the same forms were reared in starvation conditions, they required, as usual, to suck blood (Bellamy and Kardons [1958]).

We class as obligate phytophages those species in which the mouthparts of the females have no cutting-tearing teeth, and hence, are incapable of piercing the skin of animals. At present we know only ten phytophagous species of black-fly of three genera – Prosimulium, Cnephia and Gymnopais (Rubtsov [1956, 1959]). However, we can assert that the number of phytophagous species is much larger, since with the methods of investigation employed up till now they have simply not been collected. Each year brings new finds in this respect. All the three named genera are characterized by certain primitive features which systematists agree are more ancient, and which they all assign to the beginning of the system. Among these primary, more primitive features we include, for instance, the additional radial vein on the wing, the simple hairs (instead of spinules) on the wings, the absence of a pedisulcus and calcipala on the legs, the imperfect cocoon, the treelike branching of the respiratory filaments, the presence of two to six stemites in the ♀ and certain other characteristics; we must obviously include also the phytophagous habit of many species of these genera.

The larvae of all the phytophagous black-fly species grow up in the same places as other bloodsucking species. From a general consideration of the nonselective nature of food capture we must attribute the different course of histolysis and histogenesis in such cases not to the composition of the food entering the gut, but to selective assimilation and special modes of building up food reserves, characteristics which are not governed by existing ecological relations but by special constitutional features formed during the evolution of the species.

By the gonotrophic cycle we understand the set of processes of nutrition and concomitant development of the sexual products at all phases of metamorphosis of the insect from larva to imago. We have already given our reasons for adopting this concept of the gonotrophic cycle (Rubtsov [1956]). Here we will only note that in phytophagous species the feeding of the adult insects (carbohydrate food) is reduced to a minimum or is absent altogether. The eggs develop, ripen, and are laid almost solely at the expense of the reserves stored up by the larva. The concept of the gonotrophic cycle, prevalent mainly in the literature on mosquitoes, as the development of the sexual products in conjunction with the digestion of ingested blood, in this case is devoid of any specific content or real meaning. The ripening of the sexual products without supplementary feeding on blood is not a special case and is very common not only in phytophagous species, but in facultative bloodsuckers also.

The main part of the cycle of development of the sexual products (if we consider the number of qualitative changes) occurs in the larval phase. At the same time, this larval stage of development of the sexual products is outwardly similar in the different groups – phytophages and bloodsuckers. The differences, as will be shown in detail below, begin in the pupal phase and are most pronounced in the adult insects. In view of this, and also in view of the fact that the last stages of the gonotrophic cycle in the imago have been investigated more fully, we will give a general treatment of the development of the ovaries and their associated organs in the larval phase of phytophagous and bloodsucking species.

MATERIAL AND METHODS

Two species of phytophagous black-flies were studied: the alpine black-fly (Prosimulium alpestre Dor. et Rubz.) and the Karelian black fly (Cnephia lapponica End.). Fragmentary information was obtained for Gymnopais bifistulatus Rubz. The P. alpestre and G. bifistulatus material was collected in Eastern Siberia, from brooks running into L. Baikal. All the phases of development of the C. lapponica were obtained in abundance near Leningrad, from the R. Kamenka in the environs of Shuvalov. Here this species develops in company with ten other species (all the bloodsucking mouthparts). Abundant among them was one of the most obligate bloodsuckers of Leningrad Region – Simulium argyreatum Mg.

The development of the sexual products was studied mainly in living material: The larvae were opened up in physiological saline or in Ephrussi and Biedel's fluid. The formed cellular and noncellular elements of the hemolymph and sexual products were stained with basic and acid vital stains – neutral red, methylene blue, Janus green, and trypan blue. For demonstrating fat we used Sudan III (solution in alcohol or lactic acid). In addition, we prepared permanent mounts fixed with Gilson, Carnoy, Schaudinn, or alcohol, and stained with hemalum and Nocht-Maximow's azure eosin. To reveal proteins we used Feulgen's light green, Brachet's toluidine blue and bromphenyl - blue. Glycogen was demonstrated with Lugol's fluid or the PAS reaction (periodate + Schiff's reagent).

GENITAL RUDIMENTS AND FOOD RESERVES IN LARVA

The genital rudiments (oogonia), like all the other important organs (digestive tract, outer and inner layers of fat body, the hemolymph with its cellular elements, the nervous system, musculature, etc.) are laid down and become differentiated in the egg. In the larval phase they develop further, and in the pupal phase they finally assume the form required by the adult insect.

In the newly hatched first-instar larva the largest and best differentiated organs are the nerve cord, digestive tract, outer layer of fat body, musculature, organs of attachment and organs of food capture. The inner layer of the fat body, like the genital rudiments, is represented by a group of small (about 3 μ) cells. The genital rudiments lie along the sides of the hindgut, and the poorly differentiated cells of the inner layer of the fat body – anterad of the genital rudiments – also lie mainly along the sides of the gut. The midgut is furnished with a peritrophic membrane and fat droplets are found inside it. The greatest amount of fat, in the form of droplets of various sizes, is concentrated in the cells of the outer layer of the fat body. The outer layer of the fat body in the first-instar larva is not an almost unbroken sac, as is the case later on, but consists of a series of cells grouped segmentally (Fig. 1). Some of the cells are isolated, while others form groups, particularly at the hind end of the body. The shape of the cells is irregular and very variable – triangular, ameboid, often with outgrowths, elongated, anastomosing with other cells. The outer boundaries of the cells are not distinct. The nuclei are small and are usually indiscernible in ustained live preparations. The most obvious and largest components of the cell are spherical fat droplets of varying size. They fill or even pack the cell, almost touching or fully contiguous with one another. In the cells of the outer layer of the fat body there can be seen, besides the fat droplets, and mainly in the outer layer of cytoplasm, small dark brown or black granules of protein nature, about 1μ long. These cannot be regarded as pigments, or as excreta of the organism, when we consider their development and their role in the organism (Rubtsov [1959]). Similar protein granules are also found in the egg, and are abundant in the hemolymph of the first-instar larvae. Besides these, the fat cells of the outer layer apparently contain pigments and granular excreta, indistinguishable externally from the protein granules. Their true nature can only be revealed by chemical reagents. At the

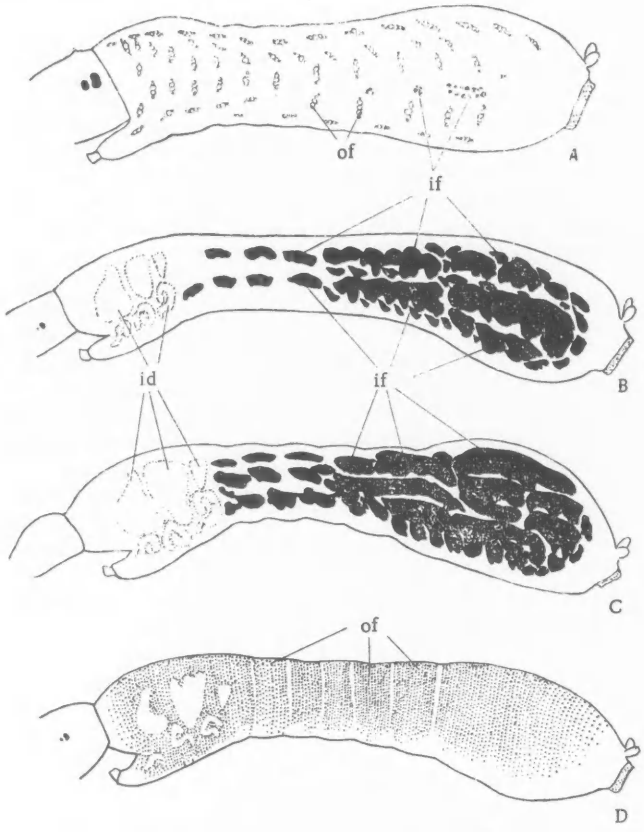


Fig. 1. Fat body of larvae. A) first-instar larva of Odagmia ornata Mg; B) last-stage larva of Cnephia lapponica End.; C) last-stage larva of Gymnopais bifistulatus Rubz.; D) last-stage larva of Prosimulium alpestre Dor. et Rubz. Symbols for Figs. 1-5: ad) adipocyte; amp) seminal ampulla; p) protein granules; pi) protein granules of inner layer of fat body and adipocytes; po) protein granules of outer layer of fat body and granular leucocytes; v) vacuole; if) inner layer of fat body; h) hemocyte; gr) gregarines; fd) fat droplets; y) yolk; gh) granular hemocytes; id) imaginal disks; fn) false nuclei; ma) macronucleocytes; mi) micronucleucytes; n) nephrocyte; of)outer layer of fat body; nc) nurse cells; pr) proleucocytes; r) glandular-muscular reservoir of testes; t) testes; vd) vas deferens; spz) spermatozoa; f) follicle; fe)follicular epithelium; ch) chorion; oe) oenocyte; ex) excreta; me) midgut epithelium; oec) oenocytoid; o) ovary; oo) oocyte; ov) ovariole; e) egg.

same time the protein granules, which are dark in color, possibly act as pigments (for heat uptake). In some species (genera Odagmia, Gnus, etc.) the cells of the outer layer of the fat body are of a wine-yellow color.

Cells very similar to those of the outer layer of the fat body are found on the nerve cord, mainly between the ganglia. They are oval or round in shape, and of a wine-yellow color; the sizes usually vary from 7 to 10 μ. We identified them as oenocytoids. In the literature they are sometimes called connective tissue.

Occasionally (as we observed in Gnus cholodkovskii Rubz. and G. relictum Rubz.), we found larvae in which the usual fat cells of irregular form with outgrowths were replaced by round cells of pale wine-yellow color with very tiny spherical fat droplets and protein granules, mainly near the surface of the cell. In shape and size they were very similar to the oenocytoids covering the nerve cord. We were unable to establish either the significance of these differences or in what way such larvae differed in later development. The comparative scarcity of such larvae (one individual per 100-200 normal individuals) rules out the suggestion that we were dealing with larvae of different sex. It is very probable that in this case we were confronted with a pathological form due, perhaps, to infestation by parasites or defects in metabolism and growth. In these larvae the segmental disposition of the cells of the outer layer of the fat body was particularly clearly seen. The cells were grouped along the aorta on the dorsal side of the body, along the Malpighian tubules at the hind end of the body, and between the ganglia of the nerve cord on the ventral side of the body. Oenocytoids were also found in the single thoracic leg, in the sides of the head and below the eyes, and also on the sides of the rectum in front of the anal opening. The hemolymph was poor in cellular elements. Proleucocytes and undifferentiated mesenchymal elements predominated. All the cells were of small size, around 3-5μ.

As we noted above, the genital rudiments are found in the form of a group of cells in the hind part of the body along the sides of the gut. In close proximity to them or contigous with them lie several oenocytoids, similar in structure to the oenocytoids covering the nerve cord.

No tracheal system is found in the first-instar larvae, and, as authors (Wagner [1925]) who have specially studied the tracheal system believe, they do not possess one and breathe through the skin.

None of the giant cells typical of later-stage larvae are found, even in the silk glands, which are later distinguished by the very large sizes of the cells.

The second-stage larva, both in size and internal structure, resembles the first-stage larva. The cells are still much the same in size and structure i.e., they are still small, and the cells of the outer layer of the fat body still predominate in number. The number of the cells is now much greater. In the outer layer of the fat body the number of segmentally arranged cells can no longer be counted and in places they form syncytia. The boundaries between the cells and the nuclei are frequently seen. The cells contain, besides a greater number of spherical protein granules, larger oval protein inclusions. The relative amount of fat in them is reduced. The hemolymph contains more dark and light spherical protein granules. The number of mesenchymal cells, including the cells of the inner layer of the fat body, is greater, but on the whole, their number, as compared with the number of cells of the outer layer of the fat body, is still small. The number of cells in the genital rudiments has increased and they consist of a small cluster of tiny and barely discernible cells. Typical of the second-stage larva as a whole is the increase in the number of cellular elements, which still retain (outwardly) their embryonic nature (small size, insignificant number of fat-protein inclusions, poor differentiation or outward lack of difference between difference cells). The number of cellular elements in the hemolymph is small, but there is a considerable increase in the number of dark granules identical with those found in the cytoplasm of cells of the outer layer of the fat body. Many of these granules in the hemolymph are dumbbell shaped, sometimes with a very slender connection, or in pairs, stuck together at first, and then separating (Fig. 4, po). From observations on the development and behavior of these protein granules in the hemolymph it would appear that they multiply by simple division. They disappear as if dissolving in the hemolymph. We regard them as specialized symbiotic bacteroids.

In the larva of the penultimate (3rd) stage there is a marked differentiation of all the cellular elements. The genital rudiments of the males and females can now be easily distinguished. In both cases they consist of oval or elongate sacs filled with dividing cells (Fig. 5, B, C). The outer layer of the fat body continues to grow and forms an almost unbroken subhypodermal layer over most of the hind part of the body, or its dorsal side at least. Almost all its cells are wine-yellow, yellowish, greenish or brownish. Their structure (shape and nature of the fat and protein inclusions, protein granules and excreta, nucleus and cell boundaries) is similar to that of larvae of the preceding stages. Frequently the boundaries between the cells and the nuclei are clearly visible in live tissue (in whole mounts under the microscope). In such cases we noted that, along with the predominating numbers of normal cells, there occurred individual nucleated cells, packed tight between the normal cells, and sometimes of a uniform yellowish or greenish color, but totally devoid of fat droplets and protein inclusions.

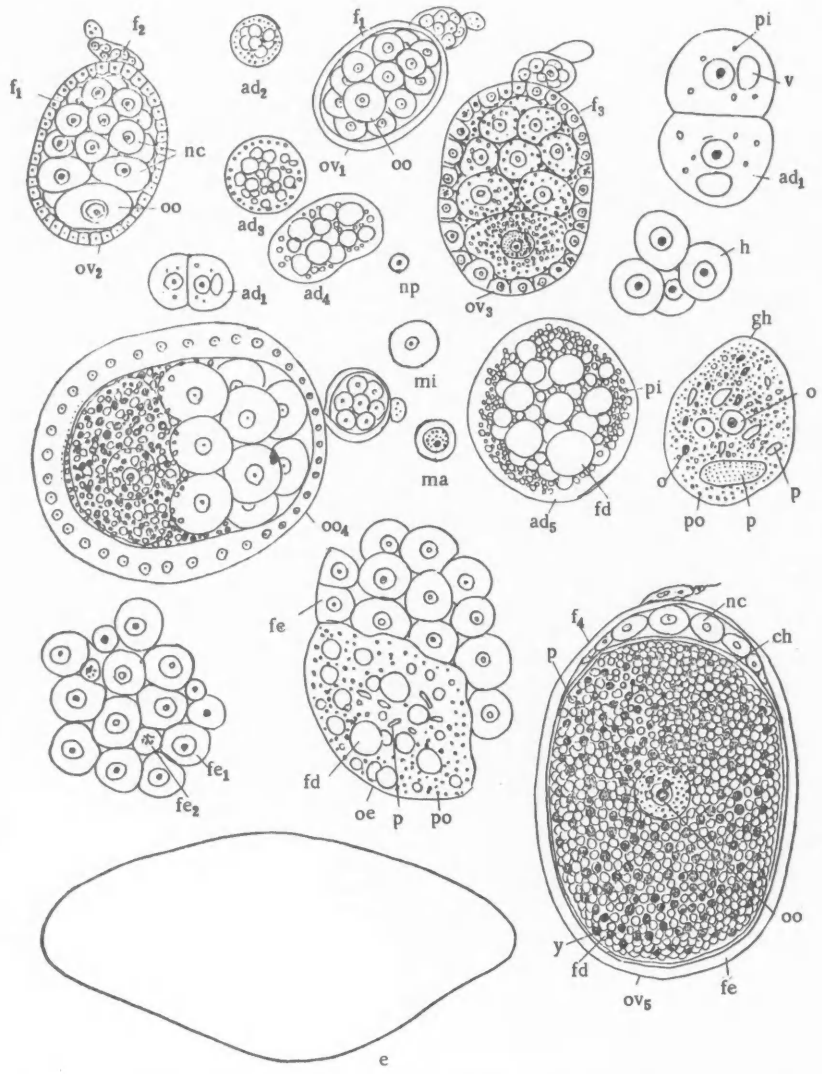


Fig. 2. Cnephia lapponica End. Ovarioles, cellular elements of hemolymph and egg in pupa; ov_5 – ovariole of Simulium galeratum Edw. 24 hr after a blood meal.

Not only quantitative, but also very pronounced qualitative changes are found in the structure and differentiation of the inner layer of the fat body and cellular elements of the hemolymph. In the mesoderm, hemolymph, silk glands, and other organs, there appear giant cells up to 30-60 μ in size. The cells of the inner layer of the fat body increase appreciably in size. There is an abundant multiplication of hemocytes. At the same time, cell multiplication, increase in size, and qualitative changes occur in the inner layer of the fat body (Fig. 3). Granular leucocytes and adipocytes are found in the hemolymph. The hemocytes and adipocytes are formed in different ways and are quite distinguishable. from the very beginning. Typical of the granular hemocytes is the presence of large numbers of small dark protein granules (similar to the granules of the outer layer of the fat body), while the adipocytes are characterized by larger (about 2μ) pale spherical protein granules, which also appear now in the cells of the inner layer of the fat body. The adipocytes, like the cells of the inner layer of the fat body, are clearly distinguished from other hemocytes by the fact that, besides the protein granules, they usually possess a vacuole, which stains well with neutral red, and several fat droplets of varying size. When the fat cells of the inner layer begin to develop the nuclei are clearly seen (in live tissue mounts). As the third-stage larva develops, the fat body grows in size, the cells become filled with protein and fat droplets, and the nucleus becomes indistinct. The largest lobes of the inner layer of the fat body are situated in the hind part of the body, adjacent to or in front of the genital rudiments. Two small narrow strands extend dorsolaterally and laterally on each side of the gut. A few small lobes of the fat body are scattered throughout the body. By the end of growth of the third-stage larva the cellular elements of the hemolymph have not only increased in number, but have also become differentiated; we now find rounded and spindle-shaped proleucocytes, ameboid phagocytes, micronucleocytes, macronucleocytes, round and oval nephrocytes, adipocytes, granular hemocytes and oenocytoids. Apart from these, the hemolymph contains very large numbers of free fat droplets of varying size, numerous dark and pale protein granules, as well as dissolved protein, revealed on coagulation by neutral red, by the biuret reaction. In the fat body, particularly in the cells of the inner layer, and in the epithelial cells of the midgut, glycogen is found, though in small amounts. Before the molt the numbers of granular hemocytes and adipocytes in the hemolymph increase appreciably. A considerable number of the granular hemocytes disintegrate, as if dissolving in the hemolymph. Similar changes occur in the cells of the outer layer of the fat body. The transformation of the cell of the outer layer of the fat body is shown in the figures. In the development of the oenocytoid the nucleus becomes indistinct, the cell boundaries disappear, and the cell contents become altered. The protoplasm becomes liquid, and consequently its form becomes rounded or spherical, while the protein granules, which have increased in numbers, become motile (Brownian movement ?). The fat droplets decrease in number and seem to dissolve away gradually. The irregular clots of protein and the nuclei of these cells also disappear. At the final stage of development the membrane of the floating oenocytoid ruptures, the dark protein granules together with the decomposed fats and proteins escape into the hemolymph. A similar process is observed in the adipocytes, particularly before the molt. The fat droplets break up, the number of protein granules increases; they often acquire mobility, and escape into the hemolymph through a break in the cell membrane. The nucleus of the cells here can only be discovered by staining. Besides this breakdown of fat and protein reserves and their escape into the blood through cell rupture, there is obviously another process as well – the diffusion of nutrient substances through the membrane of the fat body cells. This last process, more typical of adult insects, occasionally occurs in larvae of the last instar, and we will discuss it later.

By the end of the third stage the ovaries are in the form of sacs of length 100 to 150 μ, with the ovariole rudiments 8-10μ in diameter. The testes have numerous smaller cells, of diameter 3μ. Characteristic features of the third stage larva in general are the differentiation and growth of the cellular elements, and the differentiation and growth of the inner layer of the fat body, accompanied by multiplication of the differentiated cellular elements of the hemolymph. The rudiments of the imaginal disks (respiratory filaments, wings, halteres, three pairs of legs) become outwardly distinct.

Particularly typical of larvae in the last instar are two series of changes: The first is the differentiation of the genital rudiments, the development of the oocytes, nurse cells, and the follicular epithelium in the females, and the parallel development of the testes in the males; the second is the rapid build-up of food reserves, this being manifested mainly in the growth of the inner layer of the fat body. This is accompanied by the formation of the imaginal disks (rudiments of respiratory filaments of pupa, wings, halteres and three pairs of legs).

The formation of the ovarioles, i.e., the differentiation of the sexual cells and the formation of the follicular epithelium, has already begun in the penultimate larval stage, if we go by the fact that young last-instar larvae with still unformed and undarkened rudiments of the imaginal and pupal organs possess ovaries with the final number of ovarioles, each containing two follicles and a germarium. In the first (distal) follicle a uniform follicular epithelium, oocyte and nurse cells are clearly seen. In early last stage larvae the oocyte is still found to be poorly differentiated from the nurse cells and lies at the distal pole

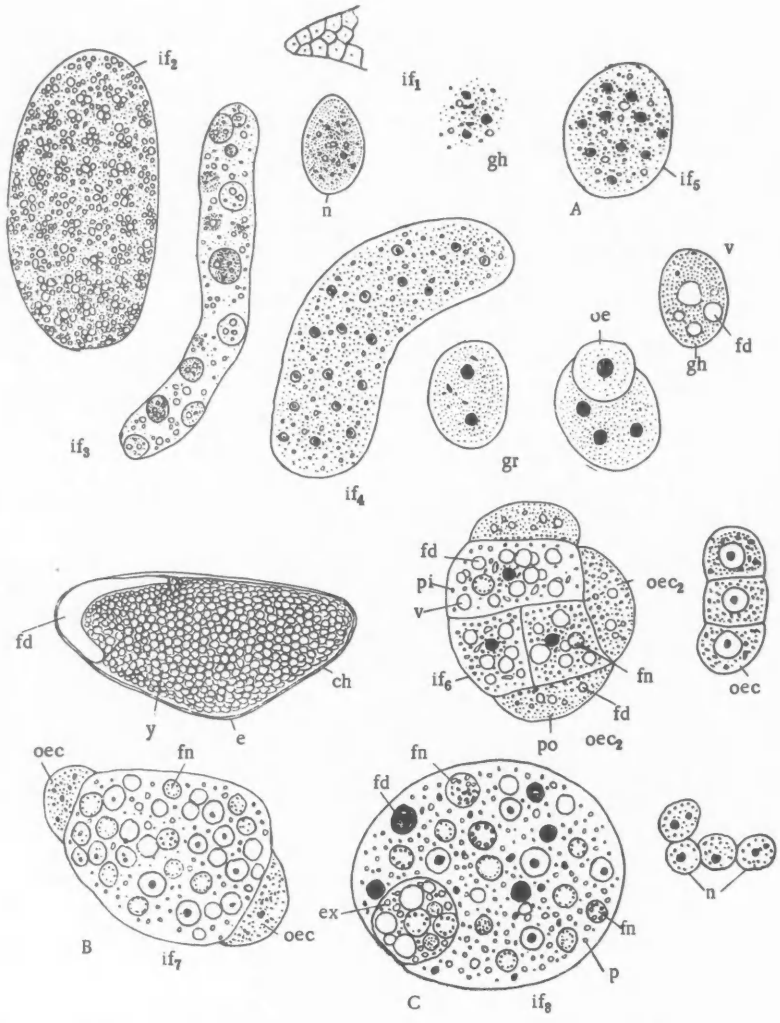


Fig. 3. Fat body, cellular elements of hemolymph, and egg in newly emerged females. A) Simulium argyreatum Mg.; B) Simulium morsitans longipalpe Belt,; C) Schönbaueria pusilla Fries; other figures from organs of Cnephia lapponica End.

of the follicle. By the end of larval development the sexual cell (oocyte) is appreciably larger than the nurse cells and in linear dimensions is $1\frac{1}{2}$-2 times greater. The ovarioles (especially the first follicle) are quite different in different species (Fig. 2 and 4). The differences affect both the relative size and shape of the oocytes and nurse cells, and the nature and structure of the follicular epithelium at different poles of the egg. In obligate phytophagous species (Cnephia lapponica, Prosimulium alpestre, etc.) the differences between the oocytes and nurse cells are less marked. The follicular epithelium reveals appreciable differences at the proximal and distal poles of the egg. It is much thinner at the proximal pole than at the distal. The follicular cells are not of equal sizes, and are obviously not of equal importance in their functions. In Prosimulium alpestre the follocular epithelium begins to function very actively, apparently before the end of larval development, judging by the appearance of yolk droplets in the first follicle.

The differences between the oocyte and nurse cells, and between the different cells of the follicular epithelium, in obligate and facultative bloodsuckers are not very pronounced at the start of development of the last-stage larva. By the end of larval development, when the rudiments of the imaginal organs are well developed, and the respiratory filaments begin to darken, the structure of the follicles in different species reveals appreciable differences in follicle size, in the relative size of the oocyte, in the sizes of the cells of the follicular epithelium and, finally, in the biochemical state of these cells, a subject about which we know practically nothing. There are no yolk droplets in the follicles and, judging from the build-up of nutrient substances, or from external features, there is no intense functional activity of the follicular epithelium.

The outer layer of the fat body reveals no appreciable differences in the structure of its cells, but the number of cells increases. The outer layer of the fat body forms an almost continuous sac under the thoracic and abdominal parts of the body of the larva. Only at the head and hindmost end of the body is the fat body undeveloped. The breakaway of oenocytoids into the hemolymph becomes very intense towards the end of development of the last stage. The fate of the oenocytoids in the hemolymph was described above. The hemolymph teems with protein granules of both forms (from the outer and inner layers of the fat body).

The inner layer of the fat body becomes many times larger. The individual cells of the fat body are crammed with fat droplets of varying size, and the boundaries between them become indistinct. The nucleus, which can be seen in young cells of the inner layer of the fat body, is indiscernible in ripe cells and can only be revealed by staining. In fat-packed cells the nucleus has an alkaline reaction and cannot be demonstrated with vital basic stains (for instance, neutral red or methylene blue). When the cell becomes exhausted and only traces of fat and protein with excreta remain, the reaction of the nucleus changes to acid and it is easily revealed with these basic stains. The growth of the fat body is due not only to the division of the cells, but also to the growth of the cells themselves, which increase in diameter from 10-15 to 30-40μ. By the end of larval development the inner layer of the fat body has become one of the largest organs. By this time, i.e., by the time the imaginal disks are formed, differences between different species and different individuals of one species as regards size and structure of the fat body body become distinct. The inner layer of the fat body is very much larger in obligate phytophagous species. The absolute volume of the fat body, according to our attempts at measurement, is about 0.2-0.5mm^3 in phytophagous species. In facultative and obligate bloodsuckers the fat body is usually not so well developed and its volume varies within fairly wide limits – from 0.1 to 0.4 mm^3. The structure and nature of the inclusions in the cells of the fat body are also quite different in phytophagous species. The fat droplets are smaller and do not vary so much in size. Their biochemical nature is different, according to the results of staining. The protein inclusions are much more in evidence. They are located mainly at the surface of the fat cells, and consequently the individual cells can easily be distinguished even in cases where the cell membranes cannot be seen.

The rapid accumulation of food reserves in the inner layer of the fat body is naturally accompanied by appreciable external changes in the gut. The fore section of the midgut enlarges owing to the increase in the number and size of the secretory glands. Around the proventriculus the fore section of the midgut forms either four budlike invaginations (genus Eusimulium), or several conical or sac-like invaginations (genera Gnus, Simulium, etc.). The epithelial cells of the mid- and hindgut become large or giant (30-60-100μ) and secrete very actively. The cytoplasm of the cell is granular, and the nuclei are clearly seen in live preparations. A food mass in the form of an emulsion of protein and fat droplets fills the space between the peritrophic membrane and the epithelium of the hind third of the midgut. Evidently the absorption and primary deposition of the food reserves take place here. With Lugol's fluid the cells of the midgut epithelium stain a reddish-brown color, thus indicating the presence of glycogen. The amount of glycogen, judging from the reaction, increases from the fore section to the hind section of the hindgut. The reaction of the fore section of the midgut is acid, judging by the deep crimson color imparted to it by neutral red.

Before pupation the gut is emptied of food. The Malpighian tubules are freed from excreta. The lumen of the tubules dilates, and spherical droplets of excreta can be seen passing into the hindgut.

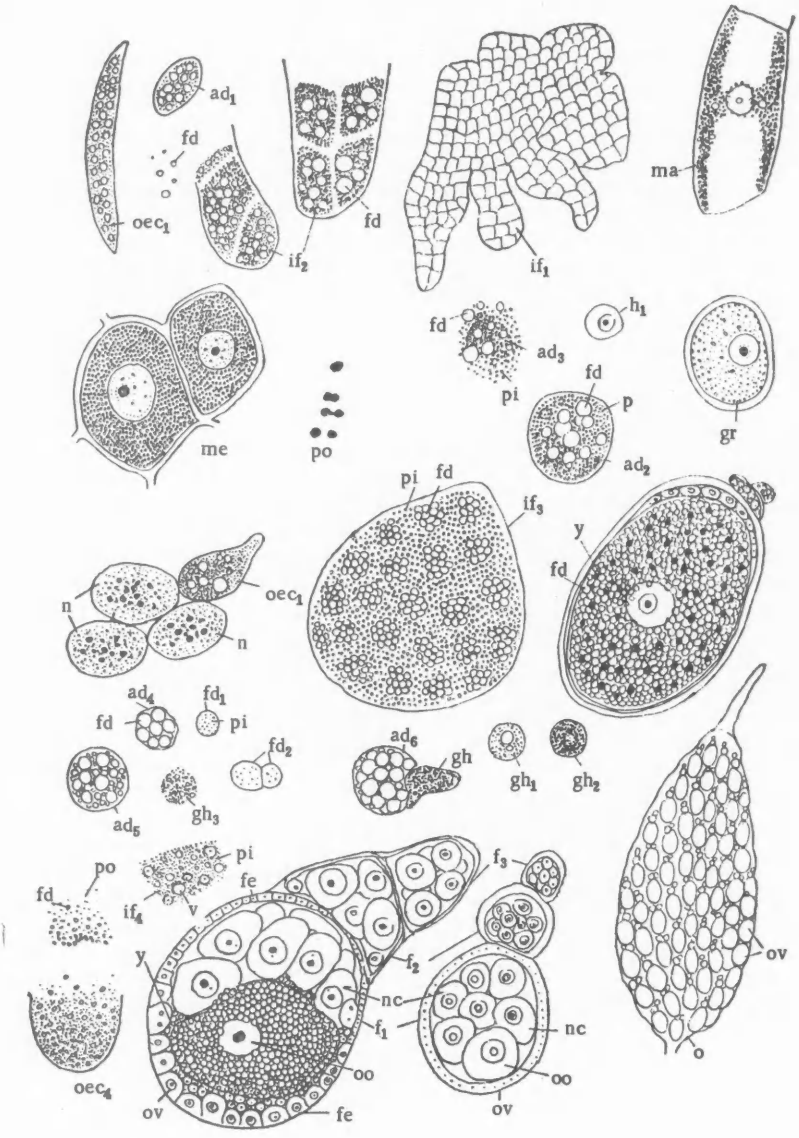


Fig. 4. Prosimulium alpestre Dor. et Rubz. Fat body, cellular elements of hemolymph, ovaries, individual ovarioles and other cellular elements of the pupa.

The main and most important differences in the internal environment of larvae of phytophagous species in comparison with bloodsuckers can be summed up as follows.

The outer and inner layers of the fat body are generally larger in larvae of phytophagous black-flies than in larvae of bloodsuckers.

In larvae of Prosimulium and Cnephia the outer layer of the fat body is very much more developed; it forms an unbroken layer under the epidermis, and hence the color of the body appears brownish or black. In Gymnopais, on the other hand, the inner layer of the fat body is more fully developed; the larva is light-colored for the most part. This last feature is typical of bloodsucking species of the genus Simulium.

In the fat body and hemocytes of larvae of phytophagous species protein inclusions of various kind predominate in volume over fat inclusions; the "pigment" granules of the outer layer of the fat body are particularly abundant, this being a very pronounced feature in the last stage of larval development.

Of course, behind these outward quantitative differences there also lie other qualitative physiological and biochemical differences in the fat body. Of these we still know practically nothing.

The further development of the sexual products in the pupa proceeds in essentially different ways in obligate phytophagous species and in bloodsuckers including facultative ones. Hence, for a clearer account of the material, it will be advisable to examine separately the development of the sexual organs in phytophagous and bloodsucking species.

DEVELOPMENT OF SEXUAL PRODUCTS IN PUPA

For an understanding of the internal environment of the pupa, in which the formation of the sexual products takes place, we must consider the diverse, far-reaching and rapid reconstruction and complete replacement of some organs by others, which are the very essence of the metamorphosis which occurs in this phase. The pronounced changes in all tissues, particularly in the fat body, the processes of histolysis and histogenesis, which very rapidly transform the larva into the pupa, and the pupa to the adult insect, make it very difficult to isolate these processes and changes in the tissues which are directly involved in the formation of the sexual organs.

In the freshly pupated pupae of Cnephia lapponica End. the ovarioles are already well differentiated, as they usually have two follicles and a germarium. The distal, or first, follicle is large (70-80μ long and 60-70μ in diameter) and of oval form. The oocyte is easily distinguished from the nurse cells and is located at the distal pole of the follicle (Fig. 2, ov_3). About 15 of the nurse cells are of rounded, and not polygonal form. The follicular epithelium consists of homogenous cells (in optical section). There are usually no yolk cells in the follicle, and if they are present, they are few. The outer and inner layers of the fat body are well-developed. The inner layer of the fat body consists of 70-80 lobes of unequal size and of various shapes. A determination of the total volume of all the lobes of the inner layer of the fat body gave a value around 0.3-0.5 mm^3. Along with the well-developed fat body the hemolymph contains very large numbers of adipocytes and granular hemocytes, with many of them in the state of breakdown to which we devoted a special account (Rubtsov [1959]). The adipocytes have small fat droplets and contain, in comparison with bloodsucking species, a great number of transparent protein granules. The granular hemocytes contain up to five to seven spherical fat droplets, along with the numerous protein granules. When treated with Lugol's solution the lobes of the fat body stained a yellowish brown color, and the individual granules around the nucleus become brownish black or reddish brown, which is obviously indicative of the presence of glycogen. The biuret reaction gave a violet color in the fat body – an indication of the presence of protein. Feulgen's stain, being a specific test for desoxyribonucleic acid, revealed it in the nucleus, in the dark granules of the granular hemocytes and outer layer of fat body, as well as in the form of a blue-violet cloud around the fat droplets (in the same cellular elements). In the adipocytes and cells of the inner layer of the fat body only the chromidia of the nucleus stained deeply. Brachet staining (reaction for ribonucleic acid) revealed protein in the form of tiny granules both in the granular hemocytes and the cells of the inner layer of the fat body. In the latter, ribonucleic acid was found in the form of tiny granules in the cytoplasm between the granules of proteins (peptides), which constituted the bulk of the protein store of the cell; these granules stained bluish with brom-phenyl blue, and pinkish violet when stained with azure eosin. Thus, the nature of the proteins and their disposition in the various formed elements of the hemolymph are substantially different. This was discussed in more detail in a previous paper (Rubtsov [1959]). The hemolymph contains dissolved protein, which appeared as crimson flocculations on staining with neutral red, and vast numbers of tiny dark and larger light protein granules, free fat droplets and other inclusions, evidently of protein nature, as they were revealed by staining with netural red, azure eosin and bromphenyl- blue. Among the dark protein granules there were many dumbbell forms or pairs displaying intense Brownian movement.

The reactions of the adipocytes and granular hemocytes, as well as of different portions of the same lobe of the inner layer of the fat body, differed appreciably. The adipocytes stained crimson-violet or orange with neutral red, while the granular hemocytes stained straw-orange. The staining of the separate lobes of the fat body (especially the small ones, from which the particles of stored nutrient were apparently

used up first) revealed in individual cells the whole gamut of transitions from straw color through orange to crimson. In these exhausted lobes of the fat body the reaction of the nucleus varied from alkaline to acid, with the nucelus taking on a distinct crimson color with neutral red. The ovaries stained light crimson with neutral red.

From the first few hours of development of the pupa the follicular epithelium begins to function intensely. Its cells become differentiated and perhaps multiply (Fig. 2, fe_1, fe_2). Droplets of fat and protein begin to enter the first follicle (Fig. 2, ov_3). The difference in the cells and nutritive substances entering the follicle are revealed by staining even in the very early stages of development of the egg. In the large cells the nucleus can be clearly seen in unstained living cells; they hardly stain at all with neutral red. The small cells, on the other hand, stain a deep dark crimson color, and on staining with asure eosin the granular or rounded nucleus is revealed. The droplets entering the follicle consist mainly of two kinds of substance: fats, which stain deeply with Sudan III and do not stain with neutral red, and protein granules, which stain well with neutral red to a crimson color (Fig. 2, ov_4).

The accumulation of yolk in the first follicle in the pupa of Cnephia lapponica End. is a very rapid process. On the second-third day the first follicle became 3-4 times larger. On the sixth-seventh day, occasionally on the tenth, i.e., by the end of pupal development, the size of the first follicle has increased to 180 x 280 – 180 x 300μ. The nurse cells move to the proximal pole of the egg and degenerate. The chorion is formed. By the third-fourth day of pupal development the oocyte can be seen shining through the mass of yolk in the middle of the follicle. On the fifth-sixth day the oocyte becomes indistinguishable from the opaque mass of yolk filling the egg. By the end of pupal development the eggs attain their final and relatively large size – 200 x 320μ. The relatively small number of eggs ripening at one time is a noteworthy feature. Each ovary contains about 70 eggs; the total number of eggs per female thus amounts to about 150 and occasionally reaches 200. During the development of the eggs many of the lobes of the fat body become much smaller, their total number decreases, and they become poorer in fat and protein inclusions. The ovary as a whole carries a few large oenocytoids (30-40μ), rich in fat droplets and protein inclusions of irregular form, and, as usual, with dark protein granules (Fig. 2, 3, 4, p).

In the pupal phase the formation of the other adult organs absent in the larval phase is accompanied by the appearance and development of parts of the sexual organs; the spermatheca, accessory glands, sperm ducts, tube glands in the females, and the genital appendages in the males.

The development of the sexual products of the males in the pupal phase is also faster in phytophagous species. By the time that the males emerge they are provided with fully formed sexual organs with ripe motile spermatozoids (Fig. 5). The males are distinguished by their smaller size, being one-third to one-half of the size of the females The fat body is also less well-developed.

In Prosimulium alpestre Dor. et Rubz (Fig.4) the development of the sexual products and fat body follows the course described above. As in C. lapponica, the inner layer of the fat body in the larva of P. alpestre has attained a large size by the time of pupation. The fat body (outer and inner layer), the granular hemocytes and adipocytes are characterized by relatively large sizes and a large amount of protein in them. The outer layer of the fat body and the genetically related granular hemocytes are particularly well developed. In both the fat body and the hemocytes the relatively large amount of protein (especially in the form of dark granules) and the small amount of fat are characteristic. The entry of yolk into the first follicle begins in the first few days of development of the pupa. The pronounced differences in the sizes of the cells of the follicular epithelium (Fig. 4, ov) are an interesting feature. The cells of the proximal section of the first follicle, i.e., the cells bounding the second follicle, are considerably smaller and obviously function less actively or in a different way from the distal cells. In the early stages of development of the follicle we managed to observe the entrance of droplets of varying size, which gave a reaction for fat and protein, and of dark protein granules as well (Fig. 2, p), into the follicle on the side of the egg.

By the end of pupal development of the first follicle is filled with yolk and has attained a size of about 200 x x 300 μ.

The second follicle and germarium as in Cnepia lapponica have almost completely degenerated by the time the development of the eggs in the pupa is completed. In comparison with Cnephia lapponica, the development of the eggs in S. alpestre is a little retarded. By the end of development in the pupa they still have a functioning follicular epithelium and the regular oval form typical of ripe eggs, although the egg membranes do not have their final form, as in C. lapponica.

The development of the eggs in the pupa of species of Gymnopais is still less advanced. In fact, the female of G. bifistulatus Rubz. emerges with unripe eggs. As regards both structure and size they obviously require further development, and this is completed in the adult insects.

EGG DEVELOPMENT IN ADULT INSECTS

In the freshly emerged female of C. lapponica the eggs have attained their final size (200 x 320μ), and if they require further development it is very slight and takes place very rapidly in the course of the first two days without any supplementary feeding. During

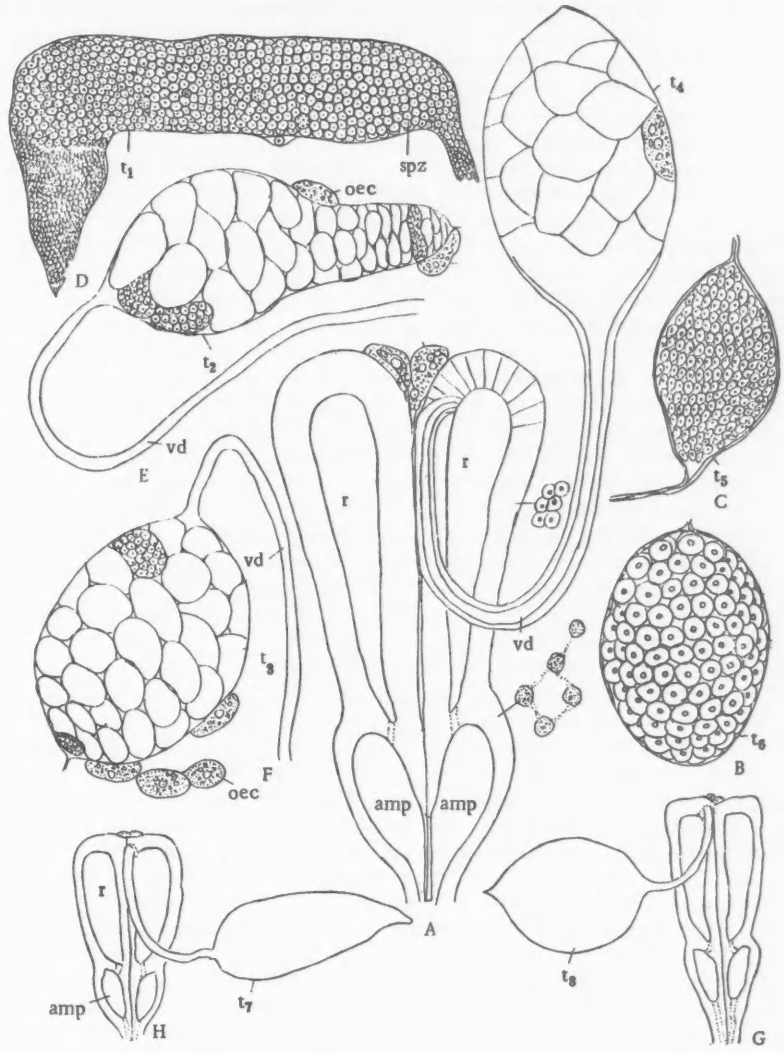


Fig. 5. Sexual organs of males. A) Prosimulium alpestre Dor. et Rubz., newly emerged male; B, C, D) Eusimulium bicorne Dor. et Rubz.: B) rudiments of testes in second-stage larva; C) the same in penultimate-stage larva; D) the same in last-stage larva; E) the same in last-stage larva of Eusimulium latipes Mg.; F) the same in last-stage larva of Odagmia ornata Mg.; G) sexual organs in newly emerged male adult of same species; H) the same in Simulium morsitans longipalpe Belt.

this time the fat body is used up and by the third day it has practically disappeared. In the freshly emerged female there are about 60-70 lobes in the fat body, with a total volume of 0.2-0.3 mm^3. By the second day this volume is halved. By the third to fourth day, even when the flies are fed on sugar, the fat body is almost completely used up. Only five to ten small lobes (size 40 × 50 × × 100 μ) remain, and these are almost free of fat and protein granules, with quite distinct nuclei and numerous excreta. Nephrocytes appear in large numbers (Fig. 2, 3, n). The hemolymph is practically devoid of adipocytes or granular hemocytes. The granular hemocytes, just like the fat body, contain hardly any fat droplets, very few protein granules and many excreta. The eggs stain pale pink with neutral red. In Lugol's solution the eggs are straw-yellow, and only one pole, though occasionally both, stains reddish brown (Fig. 3, fd).

The crop is usually swollen by the presence of liquid and contains sugar solution (in the case of artificial feeding). No formed elements could be discovered in the crop. In the laboratory (in tubes) the eggs were laid on the third to fourth day.

Our conclusions on the short time required for the ripening of the eggs after emergence of the females of C. lapponica is based on observations in the laboratory. Copulation began immediately after emergence (within 30 min – 1 hr). Copulation in C. lapponica was observed many times in the laboratory and in the field and it may be inferred that the females are able to lay eggs immediately after emergence. This was indicated by field observations. Females emerging from the water do not fly far from its banks, but copulate immediately after emergence, and then proceed to egg-laying soon after. The food reserves present in the fat body and hemocytes are obviously a supply intended mainly to provide energy for the vital activity associated with egg-laying. In the laboratory, where suitable conditions for egg-laying were absent, the fertilized females did not lay eggs before the energy reserves in the fat body had been exhausted. Features worth noting in the development of the ovaries in C. lapponica are the relatively uniform and simultaneous development of the individual ovarioles, the uniform build-up of the fat body in different individuals, the large size of the eggs and their small number. In these respects phytophagous species differ appreciably from obligate and facultative bloodsuckers.

The development of the eggs is similar in S. alpestre adults. They also copulate immediately after emergence. The fat body in newly emerged individuals is of considerable size and granular hemocytes and adipocytes are numerous. In the laboratory the males and females sipped nectar and water. Their lifetime in this case was brief and, according to my observations, lasted two to three days. I did not observe egg-laying in this species, but ripe eggs were found in the ovaries of females which had died.

The development of the eggs is obviously different in the obligate phytophage Gymnopais bifistulatus Rubz. The fact the females emerge with undeveloped ovaries and well-developed fat body indicates the need for further development of the eggs in the adult phase. Owing to the rarity of this species in the field and its very pronounced stenobiontic nature we did not manage to trace the development of the eggs of this species to its conclusion.

In all the phytophagous species there can only be one gonotrophic cycle. This can be inferred from the degeneration of the second follicle and germarium by the time the eggs in the first follicle is fully developed, the exhaustion of the fat body and hemocytes and the lack of any indication, judging from laboratory experiments, of their possible restoration. This conclusion was confirmed by field observations. The females disappear shortly after emergence and the larvae of the following generation all appear at the same time in the following spring, in April (C. lapponica) or in summer, in June (S. alpestre). Pupation (also simultaneous) in C. lapponica takes place in late June – early July, and in S. alpestre it usually occurs at the end of August.

The single gonotrophic cycle which we note here is probably also a feature of other phytophagous species, Prosimulium macropyga Lundstr., Cnephia johanseni Rubz., Stegopterna spp. etc.

SUMMARY

The development of the sexual organs in the larval phase is similar to that in bloodsucking species. Essential differences appear in the pupal stage. In early-instar larvae the outer layer of the fat body is generally well-developed, and the inner layer does not develop until the last instar. The hemocytes increase in number at molting, and are particularly numerous during the period of metamorphosis. In the pupal stage of the nonbloodsucking species of the genera Cnephia and Prosimulium the sexual organs develop more rapidly and the ripening of the eggs is more advanced than in bloodsucking species. Biochemically, the fat body adipocytes and granular hemocytes of nonbloodsucking species are distinguished by the relatively larger amount of stored protein, and the nature of the contents of the hemolymph and yolk. By the end of pupal development in C. lapponica and P. alpestre the egg in the first follicle is filled with yolk and has nearly attained its final size. The spermatheca sperm dusts, accessory glands, and tube glands in the females and the external genitalia in males develop in the pupal phase. Newly emerged adults copulate within the first few hours. In two to three days in the ovaries mature and females which have consumed only water and have had little or no supplementary feeding can

lay eggs. P. alpestre develops in a similar way, though it needs more supplementary feeding. The reserves of the fat body and hemolymph are completely used up in the first few days and cannot be renewed.

Gymnopais bifistulatus females emerge with underdeveloped ovaries and with more food stored in the fat body and hemolymph. This species needs a longer period of supplementary feeding for the sexual organs to develop fully.

Only one gonotrophic cycle is possible in all the nonbloodsucking species. All the nonbloodsucking species are univoltine, and the adults may appear either in spring (C. lapponica, P. macropyga) or in autumn (most species).

LITERATURE CITED

I. Amosova, Author's abstract of dissertation: Species of the Genus Culicoides (Heleidae) and Their Biology in the Coniferous-Broadleaved Forests in the South of the Maritime Territory [in Russian] (Zool. Inst. AN SSSR, 1956) pp. 1-19.

V. M. Glukhova, Author's abstract of dissertation: Species of Midges (Culicoides) and Their Ecology in the Karelo-Finnish SSR [in Russian] (Zool. Inst. AN SSSR, 1956) pp. 1-16.

A. V. Dolmatova, "On the ability of the ovaries in Phlebotomus papatasii (Scop.) to develop autogenously," Med. Parazitol. 15, 3, 58-62 (1946).

S. K. Enikolopov, "Autogenous reproduction of Anopheles hyrcanus Pall.," Med. Parazitol. 19, 6, 544-545 (1950).

N. G. Olsuf'ev, "The dual nature of feeding and the sexual cycle in female tabanids," Zool. Zhur. 19, 445-455 (1940).

K. K. Prokof'eva "Types of maturation of eggs in nonbloodsucking species of black-flies (Diptera, Simuliidae)," Entom. Obozr. 38, 1, 58-63 (1959).

I. A. Rubtsov, "Changes in the activity of bloodsucking black-flies in connection with the gonotrophic cycle," Tr. Zool. Inst. AN SSSR 21, 353-364 (1955).

I. A. Rubtsov, "Feeding and facultative bloodsucking in black-flies (Diptera, Simuliidae)," Entom. Obozr. 35, 4, 731-751 (1956).

I. A. Rubtsov, "The gonotrophic cycle in bloodsucking black-flies," Parazitol sb. Zool. Inst. AN SSSR 18, 255-282 (1958).

I. A. Rubtsov, "Hemolymph and its functions in black-flies," Entom. Obozr. 38, 1, 32-57 (1959).

R. E. Bellamy and E. H. Kardons, "A strain of Culex tarsalis Coqu. reproducting without blood meals," Mosquito News, 18, 2, 132-134 (1958).

D. M. Davies and B. V. Peterson, "Observations on the mating, feeding, ovarian development and oviposition of adult black-flies (Simuliidae, Diptera), Canad. Journ . Zool.34, 615-655 (1956).

J. M. Puri, "On the life history and structure of the early stages of Simuliides. Parts I, II" Parasitology 17, 295-369 (1925).

W. Wagner, Bau and Function des Atmungssystems der Kriebelmücken-larven. Zool. Jahrb., Allg. Zool. u. Physiol. 42, 441-486 (1925).

STUDY OF HOUSE FLY (DIPTERA, MUSCIDAE) MIGRATIONS IN CHITA BY MEANS OF LUMINESCENT TAGGING

A. M. Zaidenov

Translated from Entomologicheckoe Obozrenie, Vol. 39, No. 3, pp. 574-584, July-September, 1960

Research on the numerous questions connected with the ecology and biology of synanthropic flies is enabling us to assess the epidemiological significance of these vectors of intestinal infections, and to organize effective control of them.

A great number of investigations have been devoted to the mode of dispersal of these insects in various conditions. The older works were concemed mainly with the range of flight of flies from the point of release (Copeman, Howlett and Merriman [1911]; Forbes, cited by Howard [1912]; Hodge [1913]; Bishopp and Laake [1921]; Hine, cited by Hewitt [1923]; Gorodetskii and Kuznetsov [1937]). In later works the migration of flies from breeding sites to feeding sites and back was studied (Derbeneva-Ukhova [1941, 1947]). In recent years new methods, particularly radioactive tagging, have been used to verify and supplement the earlier information and to investigate new questions – flights of flies from pit privies to houses (Shura-Bura [1925]; Pimental and Fay [1955]); dispersion of flies from main breeding sites, from refuse dumps in residential areas in different climatic and geographical conditions (Lindquist et al.[1951]; Schoof and Mail [1953]; Schoof and Siverly [1954]; Quarterman, Mathis and Kilpatrick [1954]; Shura-Bura [1955]; Shura-Bura et al. [1955]; Dudkina and Berezovskaya [1957]), the mode of dispersion of flies from open nature into settlements on the outskirts of a large town (Shura-Bura, Shaikov et al. [1956, 1958], speed of dispersion of flies in metropolitan areas (Schoof, Siverly and Jensen [1952]; Shura-Bura [1955]; Shura-Bura, Shaikov et al. [1956]), and the dispersion of flies in rural areas (Quarterman, Kilpatrick and Mathis [1954]).

Other questions also of interest, include the dispersion and speed of migration of flies in plain and hill areas (Vashchinskaya [1956]), the dispersion of flies from a room in a multi-storey house (Khudadov [1957]), the dispersion of lindane (γBHC)-resistant flies from one inhabited locality to another neighboring one (Peffly and Labrecque [1956]).

In the study of fly dispersion most authors have tagged the flies in artificial conditions. The flies were trapped, or bred in the laboratory, and were then either fed in cages containing radioactive bait, or sprayed with various dyes, or tagged individually. In view of this it has been suggested that such handling of the flies might alter the nature of dispersion to some extent and adversely affect the accuracy of the final results of the study (Quarterman, Kilpatrick and Mathis [1954]; Shura-Bura and Gagaev [1956]). MacLeod and Donnelly [1956] suggest that laboratory-bred strains may differ in their behavior and viability although in the experiments of these authors the release of "wild" material and laboratory-bred material gave much the same results.

Hence, considerable interest attaches to studies in which the investigators tagged the flies in natural conditions by laying out bait containing a radioactive tracer, or by adding a radioisotope to the contents of a pit privy (Shura-Bura [1952, 1955]; Pimental and Fay [1955]; Shura-Bura, Shaikov et al. [1956]). The experiments were conducted in natural conditions for the insects.

The visiting of outside privies by house flies largely determines their epidemiological importance. Here more than anywhere else the flies can become heavily contaminated with microbes, including pathogenic ones. Hence it is important to establish experimentally the extent to which house flies visit privies in various climatic conditions, and to investigate the speed and extent of their dispersal from food objects to privies and vice versa.

In summer 1958 we set up an experiment for the purpose of studying the flight of house flies from a canteen to the surrounding outside pit privies. The flies were tagged with a phosphor (fluorescein) by the method suggested by B. L. Shura-Bura and V. L. Gagaev [1956]; the bait containing the phosphor was laid out in the kitchen and in the canteen.

That the flies cout be tagged by feeding for a short time on a concentrated bait containing fluorescein (2 ml of 1:500 fluorescein solution made with 0.1% caustic soda solution added to 50 ml of sugar solution) was verified in the laboratory. We found that when such a bait was laid out for 60-90 min in a cage containing flies previously kept on a regular diet of milk about 45-50% of the flies were tagged, and the tag could easily be found on living flies at least 72 hr later.

TABLE 1. Records of Tagged Flies on Sticky Traps Removed 24 Hr. after Exposure of Bait Containing Fluorochrome in the Experiment of July 22-24 (in Chita).

No.	Name and no. of site	No. of sticky traps	Flies trapped			Tagged specimens found				
			Total	house flies		Females	Males	Total	As % of total no. of flies trapped	As % of total no. of house flies trapped
				Total	As % of total no. of flies trapped					
1	Watch-house privy, 3	2	396	271	68.4	—	7	7	1.76	2.58
2	Privy of 1st hostel, 23	2	58	40	68.9	—	—	—	—	—
3	Privy of 2nd hostel, 21	2	65	45	69.2	—	2	2	3.07	4.44
4	Privy of school building, 24	2	71	22	30.9	—	2	2	2.81	9.09
5	First privy near living-quarters, 7	1	72	52	72.2	—	—	—	—	—
6	2nd privy near living quarters, 14	1	135	91	67.4	1	—	1	0.74	1.09
	Total in privies	10	797	521	65.3	1	11	12	1.5	2.3
1	Switchboard building 16	2	114	—	—	—	4	4	3.5	—
2	Piggery	2	416	—	—	2	1	3	0.72	—
	Total in buildings	4	530	—	—	2	5	7	1.32	—
	Total . .	14	1327	—	—	3	16	19	1.43	—

TABLE 2. Records of Tagged Flies on Sticky Traps Hung 24 Hr after and Removed 48 Hr After Exposure of Baits Containing Fluorochrome in Experiment of July 22-24 (in Chita).

No.	Name and number of site	No. of sticky traps	Flies trapped			Tagged specimens found				
			Total	house flies		Females	Males	Total	As % of total no. of flies trapped	As % of total no. of house flies trapped
				Total	As % of total no. of flies trapped					
1	Watch-house privy, 3	2	316	127	40.1	2	4	6	1.89	4.72
2	Privy of 1st hostel, 23	2	88	71	80.6	1	1	2	2.27	2.81
3	Privy of 2nd hostel, 21	2	231	129	55.8	1	3	4	1.73	3.10

TABLE 2. (continued)

No.	Name and no. of site	No. of sticky traps	Flies trapped			Tagged specimens found				
			Total	house flies		Females	Males	Total	As % of no. of total flies	As % of total no. of house flies trapped
				Total	As % of no. of total flies					
4	Privy of school building, 24	2	104	54	51.9	—	—	—	—	—
5	First privy near living quarters, 7	1	98	85	86.7	—	—	—	—	—
6	2nd privy near living quarters, 14	1	125	61	48.3	—	—	—	—	—
	Total in privies	10	962	527	54.7	4	8	12	1.24	2.27
1	Switchboard building, 16	2	266	—	—	2	—	2	0.75	—
2	Living-quarters in settlement, 4-6, 9-12	14	303	—	—	—	3	3	0.99	—
3	Office, 15	2	79	—	—	—	—	—	—	—
4	Sanitary center, 17	2	20	—	—	1	—	1	5.0	—
5	Hostels, 19, 20	10	515	—	—	2	1	3	0.58	—
6	Watch-house	2	421	—	—	1	4	5	1.18	—
7	Piggery	2	157	—	—	—	—	—	—	—
	Total in buildings	34	1761	[1585]†	—	6	8	14	0.79	—
	Houses outside settlement, 25-33	26	660	[594]	—	—	2	2	0.30	—
	Total	70	3383	[2706]	—	10	18	28	0.82	[1.03]

† It is assumed that house flies constituted at least 90%; tentative data are given in square brackets.

It is of interest to note that dead, dried flies which had fed on the fluorescein-containing sugar solution, retained the tag for many months. For instance, flies tagged in August-September 1957 and preserved in the laboratory showed bright luminescence in July-August, 1958.

The experiment was carried out between July 22 and 24, 1958 in an isolated settlement on the outskirts of Chita.

Between 3 P. M. and 5 P. M. on July 22 we hung 70 stickly fly papers in spots surrounding the kitchen/canteen – 10 in six outside privies, 34 in various buildings in the settlement, 26 in living-quarters in the immediate vicinity (Fig. 1). We used the usual shop-bought fly papers, and fixed them on the electric light flex in the center of the rooms, or to a shelf inside the privies. At 5 P. M. on July 22 we laid out Petri dishes on the tables in the kitchen and canteen (site 1). These contained the following bait: 50 ml of sugar solution containing 2 ml of a 1:500 fluorescein solution made from 0.1% caustic soda solution and with crumbled rye bread added. Twenty five dishes in all were laid out – 15 on tables in the kitchen, nine in the canteen, and one on the breadcutter.*

After some time the dishes were covered with feeding flies. At 5 P. M. on July 23, i.e., 24 hours after the dishes were laid out, the old dishes containing the bait were replaced by fresh ones. At the same time we renewed the sticky traps in the privies, in the switchboard building and in the piggery (14 traps in all). At 6 P. M. on July 24 (i.e., after 48-49 hr) the sticky traps were removed from all the sites under observation. The traps were inspected with the aid of an apparatus for fluorescent analysis of vitamins ("Krasnogvardeets" factory, type L-80, No. 69, 1954). The results of the investigation are shown in Tables 1, 2 and 3.

* Owing to the fact that the permanent dining hall was under repair the food was prepared in a temporary summer kitchen under an awning, and the food was consumed in the club building alongside.

TABLE 3. Records of Tagged Flies from Two Batches of Sticky Traps Removed 24 and 48 Hr After Exposure of Bait Containing Fluorochrome in Experiment of July 22-24, 1958 (in Chita).

No.	Name and no. of site	No. of sticky flies	Flies trapped			Tagged specimens found				
			Total	house flies		Females	Males	Total	As % of total no. of flies trapped	As % of total no. of house flies trapped
				Total	As % of total no. of flies trapped					
1	Watch-house privy, 3	4	712	398	55.8	2	11	13	1.82	3.26
2	Privy of 1st hostel, 23	4	146	111	76.0	1	1	2	1.36	1.8
3	Privy of 2nd hostel, 21	4	296	174	58.7	1	5	6	2.02	3.44
4	Privy of school building, 24	4	175	76	43.4	—	2	2	1.14	2.63
5	First privy near living-quarters, 7	2	170	137	80.5	—	—	—	—	—
6	2nd privy near living-quarters, 14	2	260	152	58.4	1	—	1	0.38	0.65
	Total in privies	20	1759	1048	59.5	5	19	24	1.36	2.29
1	Switchboard building, 16	4	380	—	—	2	4	6	1.57	—
2	Living-quarters in settlement, 4-6, 9-12	14	303	—	—	—	3	3	0.99	—
3	Hostels, 19, 20	10	515	—	—	2	1	3	0.58	—
4	Watch house	2	421	—	—	1	4	5	1.18	—
5	Office, 15	2	79	—	—	—	—	—	—	—
6	Sanitary center, 17	2	20	—	—	1	—	1	5.0	—
7	Piggery	4	573	—	—	2	1	3	0.52	—
	Total in buildings	38	2281	[2053]‡	—	8	13	21	0.92	—
	Houses outside settlement, 25-33	26	660	[594]	—	—	2	2	0.3	—
	Total	84	4710	[3695]	—	13	34	47	0.99	[1.27]

‡ See note for Table 2.

In the experiment we investigated the flights of house flies over the route kitchen/canteen – privy. In the conditions of our study such flights by house flies must take place constantly and be very numerous.

Twenty four hours after the baits had been laid out tagged specimens were caught in four of the six privies under observation (at sites, 3, 21, 24, 14), with the tagged specimens constituting 0.74 to 3.07% of all the flies trapped and from 1.09 to 9.09% of all the house flies trapped (Table 1). In the case of traps hung 24 hr after and removed 48 hr after exposure of the baits, tagged specimens were found in three privies (sites, 3, 23, 21). Thus, from the two batches of sticky traps tagged individuals were found in five out of the six privies under observation, with the percentage of tagged specimens varying from 0.38 to 2.02% of all the flies trapped and from 0.65 to 3.44% of all the house flies trapped.

As Table 4 reveals, the distance from the kitchen/canteen to the privies was not the only factor affecting the frequency of visits of flies to the privy. On one hand, the greatest numbers of tagged specimens were found in the closest privy, that of the watch house (3). But in the privy of the 2nd hostel (21) we found more tagged specimens than in the 2nd privy near the living-quarters (14), which was closer to the kitchen/canteen, while in the 1st privy near the living quarters (7) no tagged specimens were found at all. The numbers of

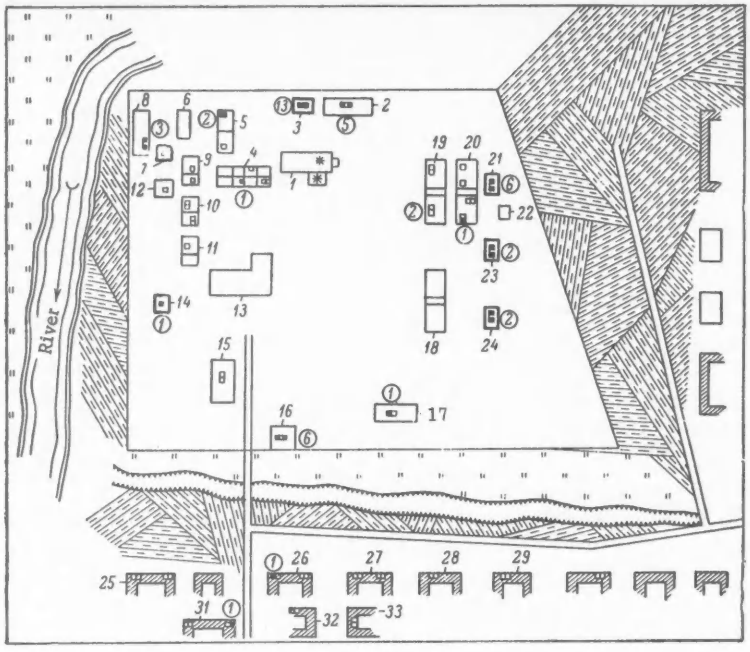


Fig. 1. Diagram of experiment of July 22-24, 1958 (in Chita). a) site of bait containing fluorochrome; b) sticky traps; the number of squares corresponds to number of traps; c) tagged flies found; d) number of tagged flies found; e) number of site; f) houses.

	22nd July				23rd July				24th July			
	1 hr	7 hrs	13 hr	19 hr	1 hr	7 hrs	13 hr	19 hr	1 hr	7 hrs	13 hr	19 hr
Relative humidity	99	100	56	66	94	83	42	59	91	91	64	82
Absolute humidity	12.9	13.4	16.5	20.0	15.6	16.0	14.4	18.5	15.8	15.9	17.0	19.1
Saturation deficiency	0.1	0.0	12.8	10.4	0.9	3.4	20.0	12.8	1.5	1.5	9.5	4.1
Total cloud	0	10	3	0	1	2	3	6	10	10	10	10
Low cloud	0	10	2	0	1	1	2	5	7	2	3	6
Direction and speed of wind	ENE_1	ENE_2	SSW_2	0	0	S_1	NNW_2	0	NW_2	N_1	SW_5	0
Rainfall per day	0.1				0				4.6			
Nature of rainfall	$1\frac{1}{2}$-$2\frac{1}{4}$ •				—				$\frac{3}{4}$-2 △	$15\frac{1}{2}$-19 △	$20\frac{1}{4}$-$20\frac{1}{2}$ ▽	
Air temperature	10.9	11.3	23.7	24.3	14.5	17.0	26.4	24.8	15.2	15.3	22.0	19.9
Mean, maximum, and minimum air temperature	17.6° 26.4 10.0				20.7° 27.6 13.8				18.1° 24.8 14.3			

a b • c △ d ▽e

Fig. 2. Weather conditions during experiment of July 22, 1958 (in Chita). a) dishes with tagged bait laid out; b) collection of sticky traps; c) moderate, continuous rain; d) light rain; e) heavy rain.

TABLE 4. Records of Tagged Flies in Privies in Relation to Distance From Kitchen / Canteen

No. of site	Dist. from kitchen/canteen (in m)	Tagged specimens found		
		total	as % of total no. of flies trapped	as % of total no. of house flies trapped
3	63	13	1.82	3.26
7	131	—	—	—
14	150	1	0.38	0.65
21	205	6	2.02	3.44
23	225	2	1.36	1.8
24	246	2	1.14	2.63

tagged specimens relative to the total number of flies caught in this privy (21) were even higher than in the closest privy, that of the watch house (3).

These figures may be explained in the following way: the privy of the 2nd hostel (21) had eight compartments and was used by people from two hostels (19, 20). The watch-house privy (3) with two compartments served only the watch house; the 2nd privy near the living-quarters (14) with one compartment was used by people who lived in the quarters, as was also the 1st privy (7). Moreover, alongside the privy near the living-quarters (7) was the piggery. Thus, the privy of 2nd hostel (21), which was most frequently used and largest in volume, was also the most attractive to house flies, despite its greater distance from the kitchen/canteen.

Tagged specimens of house flies were found in many buildings within the settlement (in the switchboard building, the two living-quarters, the two hostels, the watch house, the sanitary center, and the pigsty), and also in two houses outside the settlement, 325 and 340 m from the kitchen/canteen (Fig. 1). The percentage of tagged individuals varied from 0.52 to 1.57% of the number of flies trapped, if we leave out of account the percentage of tagged specimens in the sanitary center building, where only 20 flies were trapped. It must be noted that among the tagged specimens trapped males greatly predominated over females (19 out of 24 in the privies, 15 out of 23 in all the other sites). We could not find a satisfactory explanation of this fact.

We noted earlier that in July-August-September house flies in Chita visited outside pit privies in considerable numbers (Zaidenov [1959a, b]). This is again confirmed by the results of this experiment. Thus, on sticky traps hung right outside the privies, the percentage of house flies trapped in relation to the total number of flies trapped was 30.9 to 72.2 in the first batch, 40.1 to 86.7 in the second batch, and 43.4 to 80.5 in both batches together.

On the sticky traps we caught house flies, flies of the genus Fannia, certain other small species, and practically none of the other species of flies which breed in abundance in privies or visit them (Protophormia terrae-novae R.-D., Muscina stabulans Flln., M. assimilis Flln. and other species of flies of the families Muscidae, Calliphoridae and Sarcophagidae).

On the outside walls of these same privies we set up gauze fly traps with a bait composed of kvass and bread. The first time we set up eight fly traps, the second time seven traps, on five privies. The results of the fly-trapping are given in Tables 5 and 6.

In this paper we will not discuss the species composition of the synanthropic flies caught, and we will only note that although the numbers of house flies in comparison with all the other species varied with the mode of trapping the large-scale visitation of pit privies by house flies is an unaltered fact. This fact is significant for the epidemiology of intestinal infections and may go some way towards explaining the seasonality of intestinal infections in Trans-Baikalia. For one of the towns of Western Siberia the association between the seasonal rise in the incidence of dysentery and the phenology of the house fly has been convincingly demonstrated by I. F. Zhovtyi [1954].

The area of ground covered by the observations during the experiment was small (greatest radius from baited sites was 360 m). Such distances can be covered fairly quickly by flies, but in houses outside the confines of the settlement only two specimens, of tagged flies, or 0.3% of the number of trapped flies, were caught. In view of the relative degree of isolation of the settlement the flights of the main mass of flies were obviously confined within the limits of the settlement, though some of them dispersed outside it.

Data on the weather conditions are given in Fig. 2. If we take the following temperature limits for the activity of the flies: flight – above 12°C, normal feeding – above 15°C, and egg-laying – above 17-18°C (Derbeneva-Ukhova [1952]), then during the experiment (Chita, 1959) the number of hours when the air tempera-

TABLE 5. Numbers of House Flies in Gauze Fly Traps Set for 24 hr on the Walls of Pit Privies, First Setting – July, 1958 (in Chita).

	Site 24			Site 23			Site 21			Site 14	Site 7	
	gauze trap 1	gauze trap 6	total per site	gauze trap 8	gauze trap 9	total per site	gauze trap 2	gauze trap 3	total per site	gauze trap 10	gauze trap 5	For all sites
Total number of flies trapped	36	116	152	50	175	225	49	188	237	297	494	1405
House flies	9	28	37	11	36	47	8	33	41	181	112	418
Females	1	17	18	8	17	25	5	16	21	91	64	219
Males	8	11	19	3	19	22	3	17	20	90	48	199
No. of house flies as percentage of total no. of flies caught in gauze traps	25.0	24.1	24.3	22.0	20.5	20.8	16.3	12.2	17.3	60.9	22.6	29.7
Number of house flies as percentage of total no. of flies caught in sticky traps	—	—	30.9	—	—	68.9	—	—	69.2	67.4	72.2	65.3

TABLE 6. Numbers of House Flies in Gauze Traps Set for 24 Hr on the Wall of Pit Privies. Second Setting – July, 1958 (in Chita).

	Site 24			Site 23			Site 21	Site 14	Site 7		
	gauze trap 1	gauze trap 6	total per site	gauze trap 8	gauze trap 9	total per site	gauze trap 2	gauze trap 10	gauze trap 5	For all sites	For all sites and two settings
Total number of flies trapped	647	1168	1815	770	419	1189	434	1536	1144	6118	7523
House flies	115	136	251	98	40	138	34	525	289	1237	1655
Females	62	48	110	45	22	67	11	231	184	603	822
Males	53	88	141	53	18	71	23	294	105	634	833
Number of house flies as percentage of total number of flies caught in gauze traps	17.7	11.6	13.8	12.7	9.5	11.6	7.8	34.1	25.3	20.2	21.9
Number of house flies as percentage of total number of flies caught in sticky traps	—	—	51.9	—	—	80.6	55.8	48.8	86.7	54.7	59.5

ture was above the indicated values was:

	Above 12°	Above 15°	Above 17°
July 22.	12 hr	10 hr	9 hr
" 23.	16 "	15 "	13 "
" 24.	16 "	16 "	11 "

As this Table and Fig. 2 show, the weather conditions as a whole were very favorable for the activity of the flies.

SUMMARY

1. An experimental study was made of the flights of house flies (Musca domestica L.) over a route kitchen/canteen – privies. Within 24 hr of laying out baits containing fluorochrom, tagged specimens of flies were caught in four out of the six privies under observation. In two batches of sticky traps (48-49 hr after baits were laid out) tagged flies were found in five out of the six privies under observation, with the percentage of tagged specimens varying between 0.38 to 2.02% of all the flies trapped and 0.65 to 3.44% of the house flies trapped.

2. Besides the tagged flies found in the privies, tagged specimens were found in many buildings within the settlement (in the switchboard building, in the two living-quarters, in two hostels, in the watch house, sanitary center, piggery) and also in two houses outside the settlement, 340 to 345 m from the kitchen/canteen. The percentage of tagged flies varied from 0.52 to 1.57% of the total number of flies trapped.

3. Distance was not the only factor affecting the frequency of flights of flies from food to privies. The size of the pit, and the size of the privy were also factors governing their attractiveness for house flies.

4. The results of the experiment indicate that house flies in Chita in July visit pit privies in considerable numbers. On sticky traps hung inside the privies, the number of house flies caught was 43.3 to 80.5% of the total number caught. In gauze traps set up on the walls of the privies the number of house flies was 7.8 to 34.1% of the total number caught.

5. The luminescent tagging method proposed by B. L. Shura-Bura and B. L. Gagaev is suitable for studying house fly dispersal and allows the tagging of flies in natural conditions.

LITERATURE CITED

N. V. Vashchinskaya, "Dispersal and speed of migration of the house fly," Izvest. Akad. Nauk Arm. SSR, Biol. i Sel'khoz Nauki 9, 4, 73-77 (1956).

W. Howard, The House Fly [Russian translation] (Izd. Vyatsk, tov. 1912) pp. 1-136.

A. S. Gorodetskii and B. P. Kuznetsov, "Range of flight of house fly (Musca domestica L.)". In the book Flies. Kiev: 88-92. (1937)

V. P. Derbeneva-Ukhova, "The Ecology of Musca domestica L. and Muscina stabulans Flln." Med. Parazitol 10, 5-6, 534-543 (1941)

V. P. Derbeneva-Ukhova, "Distribution of flies in buildings in a settlement," Med. Parazitol. 16, 6, 72-79 (1947).

V. P. Derbeneva-Ukhova, Flies and Their Epidemiological Significance [in Russian] (Medgiz, Moscow, 1952) pp. 1-171.

M. S. Dudkina and M. T. Berezovskaya, "Synanthropic flies in L'vov and their sanitary and epidemiological importance," Collection of Works of the L'vov Institute of Epidemiology, Microbiology and Hygiene [in Russian] (1957) Vol. 2, pp. 31-38.

I. F. Zhovtyi, "Relation between seasonal rises in incidence of dysentery and the phenology of the house fly, Musca domestica L.," Med. parazitol. 1, 43-45 (1954).

A. M. Zaidenov, "Synanthropic fly faunta and its seasonal fluctuations around outside pit privies in Chita," Materials of the Scientific Conference on Questions of Regional Pathology [in Russian] (Chita, 1959a) pp. 34-35.

A. M. Zaidenov, "Fluctuations of fly population in Chita" (from data of 1954-1956)," Author's abstracts of Reports to the Concluding Joint Conference of the Chita Institute of Epidemiology, Microbiology and Hygiene and the Chita Branch of the All-Russian Society for Epidemiology, Microbiology and Infections for 1958 [in Russian] (1959) pp. 26-28.

G. D. Khudadov, "Use of radioactive phosphorus in the study of fly dispersal from houses," Abstracts of Reports to Scientific Conference of Central Disinfection Research Institute [in Russian] (Moscow, 1957) p. 84.

C. G. Hewitt, House Flies and How They Spread Disease [Russian translation] (Gos. Izd. Ukr. 1923) pp. 1-80.

B. L. Shura-Bura, "Experimental study of house fly migration by means of radioactive tracers," Zool. zhur. 31, 3, 410-412 (1952).

B. L. Shura-Bura, "Study of house fly migration by means of radioactive tracers," Papers Read at Fifth N. A. Kholodkovskii Memorial Lectures, April 9,

1952 [in Russian] (Acad. Sci. USSR Press, Moscow-Leningrad, 1953) pp. 12-21.

B. L. Shura-Bura, "Experimental study of fly dispersion from refuse dumps by the labeled atom method," Gigiena i Sanit 9, 12-15 (1955).

B. L. Shura-Bura and V. L. Gagaev, "Use of luminescence analysis in the study of insect migration," Entom. Obozr. 35, 4, 760-763 (1956).

B. L. Shura-Bura, E. V. Ivanova, A. N. Onuchin, A. Ya. Glazunova, A. S. Shaikov and V.Yu. Lemel'shtraikh, "Fly dispersal from refuse dumps in towns of the southern and central zones," Eighth Conference on Parasitological Problems [in Russian] (Izd. AN SSSR, Moscow-Leningrad, 1955) p. 173.

B. L. Shura-Bura, A. D. Shaikov, E. V. Ivanova, M. S. Mitryokova and K. G. Fedorova, "Migration of synanthropic flies into towns from points of release in the open field," Med. Parazitol. 25, 4, 368-372 (1956).

B. L. Shura-Bura, A. D. Shaikov, E. V. Ivanova, A.Ya. Glazunova, M. S. Mitryukova, and K. G. Fedorova, "Nature of dispersal of some species of synanthropic flies from a point of release," Entom. Obozr. 37, 2, 336-346 (1958).

F. C. Bishopp and Laake, "Dispersion of flies by flight," Journal Agr. Res. 21, 10, 729-766 (1921).

S. M. Copeman, V. Howlett and G. A. Merriman, "An experimental investigation on the range of flight of flies," Rept. Soc. Gov. Board 53,1-48 (1911).

C. F. Hodge, "The distance house flies, blue bottles and stableflies may travel over water," Science 38, 980 512-513 (1913).

A. W. Lindquist, W. W. Yates, R. A. Hoffman and J. S. Butts, "Studies of the flight habis of three species of flies tagged withradioactive phosphorus," Journ. Econ. Entom. 44, 3, 397-400 (1951).

J. MacLeod and J. Donnelly "Methods for the study of blowfly populations. II.The use of laboratory-bred material, " Ann. Appl. Biol. 44, 4, 643-648 (1956).

R. L. Peffly and G. C. Labrecque, "Marking and trapping studies on dispersal and abundance of Egyptian house flies," Journ. Econ. Entom. 49, 2, 214-217 (1956).

D. Pimental and R. W. Fay, "Dispersion of radioactively tagged Drosophila from pit privies," Jounr. Econ. Entom. 48, 1, 19-22 (1955).

K. D. Quarterman, J. W. Kilpatrick and W. Mathis, "Fly dispersal in a rural area near Savannah, Georgia", Journ. Econ. Entom. 47, 3, 413-419 (1954).

K. D. Quarterman, W. Mathis and J. W. Kilpatrick, "Urban fly dispersal in the area of Savannah, Georgia, Journ. Econ. Entom. 47, 3, 405-412 (1954).

H. F. Schoof and G. A. Mail "Dispersal habits of Phormia regina in Charleston, West Virginia," Journ. Econ. Entom. 46, 2, 258-262 (1957).

H. F. Schoof, R. E. Siverly, "Multiple release studies on the dispersion of Musca domestica at Phoenix, Arizona," Journ. Econ. Entom. 47, 5, 830-838 (1954).

H. F. Schoof, R. E. Siverly and J. A. Jensen, "House fly dispersion studies in metropolitan areas," Journ. Econ. Entom. 45, 4, 675-683 (1952).

BIOLOGY OF FRUIT FLIES OF THE GENUS DICRAEUS (DIPTERA, CHLOROPIDAE)

E. P. Narchuk

Zoological Institute, Academy of Sciences, USSR, Leningrad
Translated from Éntomologicheskoe Obozrenie, Vol. 39, No. 3, pp. 585-592, July-September, 1960

The biology of some species of the family Chloropodae has been the subject of fairly thorough study, but all the information relates to the small number of species which are cereal pests. The modes of life of the majority of species of this family are still unknown. This was the case with the genus Dicraeus until recently. This genus, which is rather distinctive in the subfamily Oscinellinae as regards its wing venation, has been fairly well worked out systematically. Collin [1946] did not give any information on biology. In a review of the nearctic Dicraeus, Sabrosky [1950] referred to the lack of accurate information on their life history, and he merely cited Frey's note [1934] that D. styriacus Strobl. was caught among the grass Elymus arenarius. Sabrosky also noted the possible association of the nearctic species D. wilburi Sabr. with Elymus virginicus, since this insect was captured in an area with this grass. The first detailed information on the biology of two species of Dicraeus was obtained by Moiseev [1950a, 1950b, 1950c].

We have managed to work out the life history of five more species of Dicraeus, so that we can now touch on the question of the food specialization of Dicraeus larvae. The observations were conducted mainly in the summer of 1958 in the environs of Tolmachevo, Leningrad Region. The area of the study lay in the subzone of southern taiga (Nitsenko [1958]). Only observations on one species – D. vagans Mg. – were conducted in the Central Chernozem Reserve south of Kursk (in 1953).

The known food plants of larvae of Dicraeus species are given in Table 1. The column "Place of observation" indicates only the locality where larvae were found on the grass mentioned. This trophic association can apparently be retained in other parts of the range as well. For instance, D. fennicus Duda was caught only on Agropyron repens in every locality where the author had occasion to collect it. Parmenter [1955] collected this species on areas with Agropyron pungens, and hence suggested that the larvae develop on this grass.

The larvae of all the listed species, apart from D. styriacus Strobl and D. wilburi Sabr., for which this has not been ascertained, feed on the developing seeds of grasses. It may be surmised that the larvae of these two species also have the same mode of life. In all the investigated species the life cycles are very similar and may be briefly described as follows. The larva, entering diapause, winters in the fallen seeds of the grass. Pupation takes place in the period of stalk-formation in the food grass; the first flies emerge when the grasses start to flower. The emergence is concerted and the flight period is relatively short. The flight is at its height when the flowering of the grasses is ending. Egg-laying takes place at the same time. The eggs are laid in the blown flowers of the grass – where the ovary has attained $\frac{1}{3}-\frac{1}{2}$ of the length of the ripe fruit. The hatched larva penetrates into the developing ovary and feeds on the endosperm and embryonic tissue, and in some cases also eats away the pericarp. The larvae fall with the seeds on to the ground and winter there. In every case there is one generation a year, this being correlated with the one fruiting of the food plant in the year.

There was little variation from this general scheme in any of the species studied. In the following account the first four species are arranged in order of the times of their appearance in Leningrad Region.

Dicraeus vallaris Collin. In Leningrad Region this is the species of Dicraeus which appears earliest. In 1958 the flight was at its height in the second half of June. The flies were distributed very locally, occurring in places where the food plant – hairy oat-grass (Helictotrichon pubescens) – was growing. The most common places were the edges of damp deciduous woods and moist meadows with rich humous soils. Unfortunately, the meadow oat-grass (H. pratense) and Schell's oat-grass (H. Schellianum) were not found in the neighborhood of Tolmachevo. Probably D. vallaris Coll. can develop on these species of grass also.

When the flight was at its height the numbers of D. vallaris Coll. on areas with flowering oat-grass were relatively high: 15-20 specimens were caught in ten sweeps of a hoop net. The flies settled in the upper layer of the grass stand, and were usually found on the spikelets of the grass. On 26/VI 12 ♀♀

TABLE 1. Food Plants of Larvae of Dicraeus Species

Species	Food plant	Place of Observation	Notes
1. D. fennicus Duda	Agropyron repens, Agropyron pungens	Leningrad Region and England	Observations of author and Parmenter • (1955)
2. D. rossicus Stack.	Agropyron caninum	Leningrad Region	
3. D. vallaris Coll.	Helictotrichon pubescens	Ditto	Author's observations
4. D. tibialis Mg.	Ditto	Ditto	
5. D. vagans Mg.	Arrhenaterum elatius	Kursk Reg.	
6. D. sp. rel. to vagans Mg.	Agropyron cristatum, A. desertorum.	Southeast European USSR, Altai, Kazakhstan, Kirgizia	Moiseev, 1950a. 1950b, 1950c.
7. D. sp. rel. to tibialis Mg.*	Ditto	Ditto	
8. D. styriacus Strobl	? Elymus arenarius	Finland	Frey, 1934
9. D. wilburi Sabr.	? Elymus virginicus	U. S. A.	Sabrosky, 1950

*In Moiseev's works (1950a, 1950b, 1950c) D. pallidiventris Macq. (=tibialis Mg.) and D. vagans were named. A careful study of Moiseev's material in the Zoological Institute collection, consisting mainly of an examination of the male genitalia and a comparison of them with the figures given by Collin [1946], revealed that Moiseev was dealing with two new species closely related to those named.

and 13 ♂♂ were collected from spikelets with an aspirator in one hour. Small numbers of flies visited the flowers of umbellifers growing nearby. Shtakel'berg [1958] noted a few flies visiting the flowers of Anthriscus.

When the females emerge the eggs are still undeveloped, and they ripen at the expense of the large reserves in the fat body in the abdomen. Each ovary consists of 8-9 ovarioles; as egg-laying proceeds, some of the ovarioles cease to function. From a consideration of the number of young follicles the total fecundity was estimated as approximately 50 eggs. Egg-laying begins in the last third of June. The eggs are laid singly on the grass spikelets in the immediate vicinity of the ovary. Before egg-laying the female carefully inspects the spikelet, probing it with its proboscis and the cerci of the projecting ovipositor. When laying its eggs the female sits head downward on the spikelet and inserts its ovirpositor into the crack between the scales. The spikelet of H. pubescens usually contains two to three florets. The eggs are usually laid on the floral glumes and occasionally on the empty glumes or on the stigmas (Table 2). On the empty glumes and lemmas the eggs are laid on the inner surface. On the palea the eggs are laid in the groove formed between the two ribs on the outer side of the scale (Fig. 1).

Egg-laying coincides with the end of flowering of the grass. The eggs are laid on blown spikelets, where the florets have shed their anthers. The ovary

TABLE 2. Sites of Egg-Laying of Dicraeus Vallaris Coll.

Site of egg-laying	Number of eggs found
Lower glume.	1
Upper glume.	2
Lemma.	14
Palea.	7
Stigma.	3

Fig. 1. Palea of Helictotrichon pubescens with egg of Dicraeus vallaris Coll.

by this time is 1.5-2 mm long. Rarely eggs are found on florets where the ovary has attained a length of 3 mm. The eggs are not usually laid on the upper floret in the spikelet, where the fruit often fails to develop completely.

From eggs laid in the laboratory and kept in an incubator at temperature 24-25° larvae began to emerge on the fourth day. Approximately an hour before the emergence of the larvae movement of the mouth hooks could be seen. The larva emerges through a longitudinal break in the chorion in the region of the micropyle. A mass hatch of larvae took place between 28/VI and 2/VII. The newborn larva is semitransparent, whitish, and about 0.8 mm long; the larva penetrates into the ovary and feeds on the nutrient substances with which the ovary is supplied. A seed containing a young larva appears no different from healthy seeds. As the larva devours the seed contents the damaged grain dries up a little and turns yellow more quickly than a healthy seed. The pericarp becomes brown. At first the larvae feeds on the endosperm and moves around as it feeds. Then the embryo is devoured and the head of the larva, which has now attained its third instar, protrudes through the seed coat. By this time the larva fills the whole grain. Subsequently the larva also devours the pericarp. When it has finished feeding, the larva turns head upward and lies freely between the floral glumes. The fully grown larvae are yellow, inactive, and about 4 mm long. They are somewhat flattened dorsoventrally, but their dorsal side is more convex than the ventral side. A flattened rib extends along each side of the body.

The larvae reach their third instar in the second half of July. In mid-July the ripe seeds begin to fall. The seeds and floral glumes fall together. The larvae of D. vallaris Coll. fall on to the soil along with the seeds. The fruit often falls before the pericarp is eaten away and the larva finishes its feeding in the fallen seed. No differences were observed in the times of falling of healthy and damaged seeds. The total infestation of seeds of the hairy oat-grass by D. vallaris Coll. larvae in 1958 was 7-8%.

Dicraeus tibialis Mg.is found in small numbers in Leningrad Region. Shtakel'berg [1958] records only one specimen (♂). During the summer of 1958 I managed to collect seven specimens. D. tibiallis Mg was found in the same spots as the previous species, but appeared several days later. During the egg-laying period females were caught on the spikelets of the hairy oat-grass (Helictotrichon pubescens). In the females two eggs ripened simultaneously in the ovarioles, so that in each ovary 16-18 eggs ripened at once. This has never been observed in other species of Chloropidae which have a long egg-laying period, for instance in species of Oscinella. It can probably be regarded as an adaptation to a short period of egg-laying. Owing to the very small numbers of D. tibialis Mg, I was unable to determine the number of seeds attacked.

Falcoz [1921] reports that this species was bred out from a mole's nest. Probably the larvae arrived there in fallen seeds among the soil litter. The same information was given by Séguy [1934].

Dicraeus rossicus Stack. As distinct from the above two species D. rossicus Stack. is a more shade-loving and moisture-loving species. The flies live in the shade of moist deciduous woods, among bushes, and on the banks of woodland rivers and brooks. In the neighborhood of Tolmachevo D. rossicus Stack. was collected near small woodland rivers, the Yashchera, Kamanka, and Ostrovenka – tributaries of the R. Luga, and also near woodland brooks. The first specimens were collected on 4/VII in a damp deciduous wood bordering a stream south of Tolmachevo on flowering bearded couch (Agropyron caninum) and in fairly large numbers on flowering floating sweet-grass (Glyceria fluitans). This latter plant was regarded at first as the food plant of D. rossicus Stack. Later it was discovered that in other localities D. rossicus Stack was never found on the sweet grass. Numerous examinations of the spikelets of sweet-grass revealed neigher the eggs nor the larvae of D. rossicus Stack. On 26/VII D. rossicus Stack. was observed in flight among patches of A. caninum near the R. Kamenka, and eggs and larvae of this species were found in the seeds. The flight of the adults lasted about a month, throughout July. The female has ovaries consisting of ten ovarioles in each. In each ovariole three eggs ripened simultaneously (Fig. 2). The adaptive significance of this was mentioned above. The mean fecundity of a single female, according to the number of young follicles, was more than 100 eggs.

By 26/VII most of the larvae had hatched from the eggs; in an examination of inflorescenses of A. caninum 16 empty skins and only four whole eggs were found. From two of the eggs the larvae hatched out the same day. In cases where empty chorions were found, first-instar larvae were also found either inside or outside the ovary. The eggs were usually laid on the palea, and occasionally on the stigma or ovary (Table 3).

The palea in A. caninum is elongate-oval, with pointed apex and with two nerves; the nerves from two longitudinal ribs. The margins of the scale are inflexed and form two narrow folds. The eggs are usually laid behind these folds (Fig. 3). It is of interest to note that in the two cases where the eggs were found on the outside of the palea, the anthers in both the flowers had dried up, though they had not been shed, and they filled the cavity between the floral glumes. Usually the eggs are laid at the end of the flowering period, after the anthers have fallen.

Fig. 2. Ovariole of Dicraeus rossicus Stack. with ripe eggs.

Fig. 3. Palea of Agropyron caninum with egg of Dicraeus rossicus Stack.

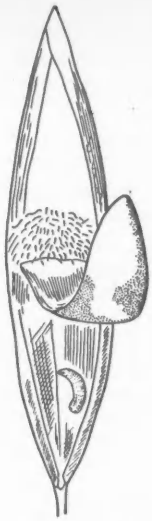


Fig. 4. Young larva of Dicraeus rossicus Stack. in ovary of Agropyron caninum

TABLE 3. Sites of Egg-Laying of Dicraeus rossicus Stack

Site of egg-laying	Number of eggs found
Palea, behind fold	13
Palea, outer side	2
Stigma	2
Ovary	3

When the larvae emerge the ovary is 1.5-3 mm long. The larvae usually enter the ovary on the side of the lemma, i.e., from the ventral side of the seed. At first the larva lies in a C-shaped pose in the ovary, and eats away small portions of the endosperm (Fig. 4). In first instar larvae the head end of the body is slightly swollen. The young larva can be variously oriented in the ovary, depending on the site of entry. Towards the end of its growth the larva always turns head downwards, towards the embryo of the seed, and after it has devoured the embryo it turns head upwards.

The larvae complete their development by the last third of August. The fully grown larvae have the same yellowish coloration and form as those of D. vallaris Coll. They either lie freely between the floral glumes or are found within the undamaged pericarp. In the first case the grain is completely consumed, with the exception of the small apical fibrous part. In the second case the pericarp is quite whole, and the injured seed can be distinguished only by the fact that it is slightly wrinkled and darker than normal. Sometimes the larva lie inside the pericarp which has been eaten through in only a few spots. These three types of damage were found in the ratio 3:3:1 respectively. Moiseev [1950a] indicated that the differences in the extent to which the component parts of the flower were eaten were a species-specific feature of the two species which he studied. It would appear that the different degree of feeding on the pericarp in this case at least, depends on the time the seeds are infested. In fact, first-instar larvae newly hatched from the egg can be found in ovaries varying in length from 1.2-3 mm. The entry of the larva into the ovary does not usually affect the growth of the ovary. Damaged ovaries, where the pericarp was still retained, did not differ in size from healthy ones. In some cases we observed that larvae had eaten up all the endosperm and part of the pericarp, without attaining their full growth. Probably the ovary was damaged at such an early stage of its development that it died, and the further supply of nutrient substances ceased. What was the later fate of these larvae – whether they moved onto other seeds in the same spikelet, or whether theyperished – I could not discover. It may be inferred that some of the larvae perished. For instance, in an examination on 26/VI, when the seeds contained first-instar larvae, the degree of infestation of the seeds was found to be 13.5%. In an examination of ripe fruits from the same place on

17/VIII, when the seeds contained fully grown larvae, a slightly smaller figure was obtained – 10.2%. In the first case the degree of infestation was probably an underestimate, since it was fairly difficult to find the small first-instar larvae, which are transparent and less than 1 mm long.

Dicraeus fennicus Duda. This is the commonest species in the Leningrad Region and in the whole European part of the USSR. It is found in wet and dry meadows, on long-fallow land, on the edges of fields, and on waste ground. The larvae develop in the seeds of couch grass (Agropyron repens). This species has the longest flight period – in 1958 it was caught from the first third of July to mid-August, i.e, over a period of about one and a half months. The flight began when the spikelets were forming on the couch grass. This long flight period coincides with the long period of flowering of the couch grass.

In females emerging from the puparia the eggs were not developed, the last follicle was at stage N. The ovary consisted of 10-11 ovarioles, each of which contained two eggs at one time. The mean fecuncity was approximately 70-80 eggs. Egg-laying began in mid-June. The eggs were laid on the blown spikelets which had shed their anthers. At the time of egg-laying the ovary was 2-2.5 mm long. The structure of the palea in A. repens is very similar to that in A. caninum – the same folds are formed on the inner surface. The eggs were laid most often behind these folds. On rare occasions the eggs were laid on the stigma or inner surface of the lemma (Table 4).

When the eggs developed in an incubator at 24-25°C the larvae appeared on the fourth to fifth day. The larva ate the endosperm and embryo. In all the observed cases the fully grown larvae, which had finished eating (this could easily be determined from the head-upward position of the larva), were always found inside the undamaged pericarp.

Great mortality among the larvae was observed during their growth. This resulted from the fact that in 1958 a considerable number of the ovaries in A. repens perished, primarily due to fungal diseases. In the egg stage the degree of infestation of the florets of A. repens was very high – up to 25% on the average and varied between 10.7 and 93%, (the latter only on one spikelet). In an examination on 2/IX, when the larvae had finished feeding, the infestation was only 6.6% on the average, varying from 0 to 18.7% in individual spikelets, and in two-thirds of the florets the fruits were undeveloped.

Dicraeus vagans Mg. Observations in the Central-Chernozem Reserve were begun on 2/VII/1953. By this time the flight of D. vagans Mg was finished and not a single specimen of this species was collected. On 13/VII white flattened inactive larvae about 4 mm long were found in the spikelets of the tall oat-grass (Arrhenaterum elatius). The larvae lay freely between the floral glumes. The larvae mainly colonized the lower branches of the panicle. The same larvae were also found in fallen oat-grass seeds among the litter.

TABLE 4. Sites of Egg-Laying of Dicraeus fennicus Duda

Site of egg-laying	Number of eggs found
Palea, behind fold	36
Lemma, inner surface	3
Stigma	7

From the larvae collected in September and kept at first in the cold and then at room temperature, one speimen of D. Vagans emerged on 13/IV of the following year and the rest on 2-5/VI.

A. elatius has been introduced into cultivation in N. America, Japan and Australia (Rozhevitz [1937]); I do not know of any mention of damage to its seeds in these countries. This, or course, is no evidence for the occurrence or absence of D. vagans Mg in these countries. In our country Agropyron cristatum was introduced into cultivation in 1900, but seeds damaged by Dicraeus larvae were not described till 1950, in spite of the fact that the attacking species of Dicraeus were not imported or had recently transferred to this food plant. They develop also on Agropyron desertorum

Among the characteristic features of the life cycles of the investigated Dicraeus species we note a number of adaptative features which ensure that their development coincides with the development of the food plants. There is, first of all, the long diapause which the larvae enter immediately after they complete their feeding. As a result, the flies emerge at the time when the spikelets are forming on the grass. The concerted and relatively short flight period and the manner of ripening of the eggs – two to three simultaneously in each ovariole – must also be classed among such adaptative features. In species of Oscinella, which develop on the vegetative shoots and have a long flight period, only one egg at a time ripens in each ovariole. Correlated with this, their period of egg-laying is much longer.

With very few exceptions the genus Dicraeus is restricted in its distribution exclusively to the Holarctic. Otherwise, only four species are known, two from Ethiopia and two from Taiwan. The representatives of this genus in the Palaearctic and Neoarctic are fairly distinctive; only two common species are known. Almost all the investigated food plants, apart from Elymus, are confined to the Palaearctic. Agropyron repens and Arrhenaterum elatius have been imported into N. America. The genus Dicraeus is distributed in the forest and steppe regions; unfortu-

nately, we do not have sufficient data on the distribution of these species to compare it with the range of their food plants.

The investigated food plants belong to the tribes Aveneae (Arrhenaturum and Helictotrichon) and Hordeae (Agropyron, Elymus). It is of interest to note that a relatively large number of phytophagous Chloropidae (at least 11 species are associated with the genus Agropyron, a feature which is quite unknown for any other genus of grasses. The reason for this close association is not quite clear yet. All the food plants of Dicraeus have large seeds, 5-6 mm long; the store of nutrient in them is quite sufficient for the larvae. The size of the grain is apparently one of the factors which limit the number of food plants of Dicraeus species. Another factor is the phenology of the flowering of the grass. All the investigated Dicraeus species have a relatively short flight. period two to four weeks. During this period the eggs ripen and are laid, and then the flies die. According to observations in Tolmachevo, in all the habitats with which the investigated species of Dicraeus were associated, the flight of the flies almost always coincided with the flowering of one of the species of large-seeded grasses. For instance, on meadows and wood margins Helectotrichon pubescens was always accompanied by Briza media, which has fairly large seeds, but the latter had finished flowering by the time that the flight of D. vallaris Coll. began. In damp deciduous woods Agropyron caninum was accompanied by Festuca gigantea, which begins to flower much later than the bearded couch. Species of Bromus and Festuca (pratensis and rubra), which occur along with Agropyron repens also flower much later than the couch grass. Apparently the phenological divergence is one of the reasons why Dicraeus species, which develop on Agropyron, do not transfer to the closely related cultivated species of wheat.

SUMMARY

The biology of Dicraeus vallaris Coll., D. tibialis Mg., D. rossicus Stack and D. fennicus Duda (observations in the south of the Leningrad region) and D. vagans Mg. (observations in the Kursk region) is described. The data on food specialization of the species of Dicraeus are given in Table 1.

The flies lay eggs on the spikelets in the period when the grasses flower and their larvae penetrate into the ovary and develop in the young grass seeds. The following adaptive features of life cycles in the species studied have been noted:

1. A long diapause, which the larvae enter after the cessation of feeding, so that the emergence of flies coincides with the earing of host plant;
2. the short flight time of the imagos;
3. the ripening of the eggs in the females, 2–3 in each ovariole at the same time.

LITERATURE CITED

A. E, Moiseev, "New seed pests of Agropyron cristatum flies of the genus Dicraeus Lw. (Diptera, Chloropidae)," Entom. Obozr. 31, 1-2, 77-79 (1950a).

A. E. Moiseev, "The zhitnyak (Agropyron cristatum) fly," Collection of Scientific Works of the Krasnokutsk State Plant-Breeding Station for 1944-1948 [in Russian] (Sel'khozgiz, 1950b).

A. E. Moiseev, "Flies of the genus Dicraeus as seed pests of Agropyron cristatum," Dokl. VASKhNIL 12, 33-38 (1950c).

A. A. Nitsenko, "The question of the boundary between the mid-taiga and south-taiga subzones within Leningrad Region," Bot. Zhur. 43, 5, 684-694 (1958).

R. Yu. Rozhevits, Grasses [in Russian] (Sel'khozgiz, 1937).

A. A. Shtakel'berg, "Materials on the dipterna fauna of Leningrad Region. III. Diptera Acalyptrata. Pt. 1," Tr. Zool. Inst. AN SSSR 24, 103-191 (1958).

J. Collin, "The British genera and species of Oscinellinae (Diptera, Chloropidae)," Trans. Roy. Entom. Soc. London 97, 5, 117-148 (1946).

L. Falcoz, "Materiaux pour l'etude de la faune pholéophile, 1-re note: Diptères," Bull Soc. Entom. (1921) pp. 137-142.

R. Frey, "Förtecking over Finlands Chloropider bestämda av O. Duda," Mem. Soc. Fauna et Flora Fenn, 9, 128-139 (1934).

Parmenter, "On Dicraeus scibilis Collin and D. fennicus Duda (Dipt. Chloropidae)," Entomol. Rec. and Journ. Variation 67, 5, 152 (1955).

C. Sabrosky, "The genus Dicraeus in North America (Diptera, Chloropidae)," Proc. Entom. Soc. Washington, 52, 2, 53-62 (1950).

E. Séguy, "Faune de France, 28, 1-832 (1934).

ON THE FLIGHT OF BEETLES TO THE LIGHT OF MERCURY-QUARTZ LAMPS

P. D. Zhantiev and V. B. Chernyshev

Department of Entomology, Moscow State University, Moscow
Translated from Entomologicheskoe Obozrenie, Vol. 39, No. 3, pp. 594-598, July-September, 1960

Various light sources, particularly incandescent lamps, have long been used by entomologists for attracting insects. However, their utilization for the collection of beetles has not been of any essential significance because the usual light sources are comparatively weak in their attraction for the members of this order.

The application for beetle collecting of lamps giving off ultraviolet radiation should change this situation considerably. According to almost all authors who have compared the intensity of insect flight or ordinary incandescent lamps and to mercury-quartz lamps, the latter have a distinctly stronger attraction for insects (Frost, 1954; Pfrimmer, 1955; Mazokhin-Porshnyakov, 1956a). Hence, mercury-quartz lamps can serve as a quite effective means for faunal and ecological investigations, and in some cases even for combating forest and agricultural pests. Thus, Mazokhin-Porshnyakov (1954, 1956b, 1958) proposes the use of mercury-quartz light-traps for combating dytiscids (pests of pond cultures) and May beetles.

In the median zone of the European part of the USSR far fewer beetles (in numbers of individuals) fly to light than do flies, caddis-flies, and moths. With regard to the southern regions, the data of Bogush (1951), who used incandescent lamps, and our data show that beetles fly to them in greater numbers than do the members of all other orders of insects combined.

We are here presenting the results of insect collections made at the light of mercury-quartz lamps (light bulbs), models PRK-2 and PRK-4, during the summer of 1956 at the Chashnikovskaya Agrobiological Station of Moscow University, during the summers of 1957 and 1958 at the Zvenigorodskaya Biological Station of MGU, and during July and August 1957, on the south shore of the Crimea (the environs of Yalta and the Crimean State Preserve).

A total of 37 families of beetles was represented in the catch coming to the light of the mercury-quartz lamps (see table). In addition, Mazokhin-Porshnyakov records the flight of members of 25 families, seven of which (Cicindelidae, Haliplidae, Lucanidae, Pselaphidae, Melyridae, Pythidae, and Alleculidae) are absent from our collections. Since mercury-quartz lamps began to be used comparatively recently, we are confident that this list can be considerably lengthened. Of the families listed, the ones which fly most frequently are the Carabidae, Dytiscidae, Hydrophilidae, Scarabaeidae, Staphylinidae, and Heteroceridae. The distribution of the families and genera of beetles flying in the Crimea corresponds rather closely to the analogous data for the median zone of the European part of the USSR.

As a rule, only those species which generally fly in the evening or at night come to light. The specific composition of the beetles flying in is distinguished by certain characteristics. Very often species which are rarely caught in a given locality by the usual collecting methods fly in great numbers and those which are ordinarily very common are almost never observed. For instance, in the Zvenigorod district of the Moscow region it is almost impossible to find Ophonus calceatus Panz. and very easy to collect O. pubescens Müll., while at light the former comes constantly and the latter is extremely rare. Similarly in the Crimea Badister bipustulatus Bon., a rather rare carabid in this region, comes in considerable numbers.

Naturally, not all of the species of a given family inhabiting the collecting area will fly to light, but only some of them. In many cases it is very difficult to understand why, for instance, Amara majuscula Chd. flies abundantly while the other species of this genus do not, or why several species of Aphodius also do, with the exception of one of the most widespread – A. fimetarius L. Several species are both rare visitors to light and difficult to catch by other methods (for instance, species of the family Lymexylonidae). It may be supposed that these species are truly rare, as opposed to forms which are hard to find. It follows from this that by merely combining different methods of collecting one may estimate the rarity of a given species.

As previously pointed out, the mercury lamp attracts many more different insects than the incandescent lamp. It appears that Necrophorus, Geotrupes, Orchestes, and Curculio fly only to ultraviolet rays.

Members of the latter genus (especially C. glandium Marsh.) flew in such large numbers on the south shore of the Crimea that we can recommend quartz light-traps for estimating the numbers of this pest or even for exterminating it in oak seeded plots in southern tree farms. The collection of this pest at light is facilitated by the fact that the adults usually inhabit isolated groups of trees or the edges of oak groves.

Flight to light is generally very uneven. In the median zone beetles fly in large numbers only on warm evenings (when the air temperature is above 15-16°C). Lebedev (1933) writes that flight to light

Beetles which flew to light[1]	Flight intensity[2]		Beetles which flew to light[1]	Flight intensity[2]	
	Moscow env.	Crimea		Moscow env.	Crimea
Carabidae	+++	+++	*Elater* sp.	−	+
Calosoma denticolle Gebl.	−	+	*Melanotus fusciceps* Gyll.	−	++
Dischirius	+	−	**Bostrychidae** (*Scobicia schevrieri* Villa.)	−	++
Bembidion	++	+++	**Anobiidae**	−	++
Badister	+	+++	*Stegobium paniceum* L.	−	+
Dolichus halensis Schall.	+	+	*Ernobius*	−	++
Calathus ambiguus Payk.	−	+	*Priobium carpini* Hbst.	−	+
Agonum gracilipes Dft.	++	−	**Cisidae** (*Cis*)	++	−
Agonum	+	−	**Cantharididae**	++	−
Amara majuscula Chd.	+++	−	*Cantharis*	++	−
Amara	+	++	*Malthodes*	+	−
Ophonus calceatus Panz.	+++	+++	*Rhagonycha limbata* Thoms.	+	−
Ophonus	++	++	**Lymexylonidae** (*Lymexylon navale* L.)	+	−
Stenolophus mixtus Hbst.	−	++	**Helodidae** (*Cyphon*)	++	−
Anisodactylus signatus Panz.	−	+	**Heteroceridae** (*Heterocerus*)	+++	+++
Dytiscidae	+++	+	**Dermestidae** (*Attagenus schaefferi* Hbst.)	+	−
Rhantus suturalis Lac.	++	−	**Cleridae** (*Necrobia violacea* L.)	+	−
Colymbetes striatus L.	+	−	**Cucujidae**	+	+
Ilibius	+++	+	*Monotoma picipes* Herbst.	−	+
Macrodytes marginalis L.	+	−	*Silvanus fagi* Guér.	+	−
Gyrinidae (*Gyrinus*)	+	+	*Laemophloeus monilis* F.	−	+
Hydrophilidae	+++	+++	**Nitidulidae**	+++	−
Helophorus	++	−	*Meligethes*	+	−
Hydrobius fuscipes L.	+++	−	*Epuraea*	+++	−
Enochrus	++	+++	*Omosita*	++	−
Laccobius	++	+++	*Rhizophagus*	++	−
Cercyon	+++	+++	**Mycetophagidae** (*Typhaea stercorea* L.)	−	+
Hydrous piceus L.	−	+	**Cryptophagidae**	+++	−
Histeridae (*Platysoma*)	+	−	*Telmatophilus*	+	−
Trogidae (*Trox sabulosus* L.)	+	−	*Cryptophagus*	+	−
Scarabaeidae	+++	++	*Atomaria*	+++	−
Aphodius	+++	++	**Lathridiidae** (*Cartodere*)	+	+
Odontaeus armiger Scop.	++	−	**Coccinellidae**	++	+++
Copris lunaris L.	++	+	*Scymnus* sp.	−	+
Geotrupes stercorarius L.	+	−	*Coccinella 7-punctata* L.	+	−
Serica brunnea L.	+++	−	*Synharmonia conglobata* L.	−	+
Melolontha hippocastani F.	+++	−	*Harmonia 4-punctata* Pont.	−	++
Anisotomidae (*Liodes*)	+	−	*Halyzia 16-guttata* L.	−	+
Ptiliidae	+	−	*Vibidia 12-guttata* Poda	−	+++
Silphidae	+++	−	*Myrrha 18-guttata* L.	−	+++
Catops	+	−	*Calvia 14-guttata* L.	++	+
Necrophorus	++	−	*Anatis ocellata* L.	+	−
Necrodes littoralis L.	+++	−	**Aderidae** (*Aderus*)	−	+
Staphylinidae	+++	++	**Anthicidae**	+	++
Antrophagus caraboides L.	+	−	*Notoxus monoceros* L.	+	−
Oxytellus	+++	−	*Anthicus*	−	++
Paederus riparius L.	+	−			
Bledius bicornis Germ.	−	++			
Phylonthus	−	++			
Tachyporus	−	+			
Aleochara curtula Goeze	+	−			
Elateridae	++	++			
Agriotes aterrimus L.	+	−			
Dalopius marginatus L.	++	−			

[1] In all cases where only the genus is cited several of its species flew to light in approximately equal numbers.

[2] Mass flight − three pluses (+ + +), moderate flight − two pluses (+ +), individual specimens − one plus (+), no flight − one minus (-).

Beetles which flew to light[1]	Flight intensity[2]	
	Moscow env.	Crimea
Mordellidae (*Mordellistena*)	+	—
Oedemeridae (*Calopus seraticornis* L.)	+	—
Lagriidae (*Lagria hirta* L.)	+	—
Tenebrionidae	+	—
Diaperis boleti L.	+	—
Tenebrio molitor L.	+	—
Cerambycidae	++	+
Prionus coriarius L.	+	+
Rhagium mordax De Geer	+	+
Spondylis buprestoides L.	+	—
Criocephalus rusticus L.	++	—
Trichoferus griseus F.	—	+++
Hesperophanes sericeus F.	—	++
Acanthocinus griseus F.	+	+++
Saperda carcharias L.	+	+
Chrysomelidae	++	+++
Galerucella sp.	++	—
Haltica	+	++
Curculionidae	+	+++
Rhynchites sp	+	—
Apion	+	—
Curculio	—	+++
Hylobius abietis L.	+	—
Orchestes quercus L.	—	+++
Ipidae	+	+
Blastophagus minor Hart.	+	—
Neotomicus proximus Eichh.	+	—
Scolytus sp.	—	+

by bugs and small carabids depends on temperature to a greater degree than flight by other forms. This is evidently also true for many other beetles. This is why some entomologists often have the impression that in the median zone beetles practically do not fly to light. Why is there such a high dependence of beetles activity on air temperature? It is well known that most beetles fly comparatively poorly. For flight their body temperature must not be below a strictly determined level. Melolontha, for instance, can only fly when its body temperature is higher than 25°C (Kosmachevskii, 1948). In other insects there is not this strict dependence of flight capability on body temperature (Krogh and Zeuthen, 1941).

However, even at high air temperatures beetles fly less abundantly in the median zone than in the south. This is probably related to the fact that sufficiently warm nights occur rarely in the median zone while the relative humidity of the air may be high enough during the day. For these reasons the flight of the northern forms may be shifted to the daylight hours of the daily cycle. An analogous fact is that the spring forms fly during the day more often than the summer forms.

Entomologists sometimes miss the flight of beetles since this usually coincides with the twilight hours. Many forms (Cryptophagus, Oxytellus, Geotrupes, Liodes) fly at sunset. At this time incandescent light does not yet attract insects, whereas flight to the mercury lamp begins at light 20 to 30 minutes after sunset; with the onset of maximum darkness flight tapers off or sometimes ceases completely. Only a few Carabidae and Necrodes littoralis L. fly the whole night. Bettle flight resumes at daybreak but is usually much ligher than in the evening. At the approach of a thunderstorm all the flight periods run together and flight is at its greatest abundance.

SUMMARY

1. Collecting beetles at mercury-quartz lamps yields rich material for faunal and ecological investigations, since ultraviolet light has a significantly stronger attraction for insects than incandescent light.

2. Flight to the mercury-quartz lamp begins as early as the time of sunset, that is, earlier than flight to the incandescent lamp.

3. Representatives of 44 families of beetles, including several pest species and a series of rare forms, were collected at the light of lamps giving off ultraviolet radiation. The representatives of the following families flew in most frequently: Carabidae, Dytiscidae, Hydrophilidae, Scarabaeidae, Staphylinidae, and Heteroceridae.

4. The flight of beetles to light strongly depends on temperature and occurs primarily during the evening hours.

LITERATURE CITED

P. P. Bogush, "The application of light-traps as a method of studying the dynamics of insect numbers," Entom. Obozr. 31, 3-4, 609-628 (1951).

A. S. Kosmachevskii, "The influence of crepuscular light on the behavior of some animals," Zoolog. Zhurn. 27, 5, 435-440 (1948).

A. G. Lebedev, "Contribution to the study of the deciduous forest biocenosis,"[in Ukrainian] Zbirn. prats' Sekt. ekol. nazemn. tvarin 1, 51-78 (1933).

G. A. Mazokhin-Porshnyakov, "Utilization of ultraviolet radiation in combating harmful insects in pond cultures," Tr. soveshch. po rybovod., 404-406 (1954).

G. A. Mazokhin-Porshnyakov, "Night insect collecting at the light of the mercury lamp and the prospects of utilizing it in applied entomology,"

Zoolog. Zhurn. 35, 2, 238-244 (1956a).

G. A. Mazokhin-Porshnyakov, "Application of ultraviolet light in combating the May beetle," Zoolog. Zhurn. 35, 9, 1356-1361 (1956b).

G. A. Mazokhin-Porshnyakov, "Construction and use of insect traps with ultraviolet radiation sources," Entom. Obozr. 37, 2, 464-471 (1958).*

S. W. Frost, "Response of insects to black and white light," Journ. Econ. Entom. 47, 2, 275-278 (1954).

A. Krogh and E. Zeuthen, "The mechanism of flight preparations in some insects," Journ. Exp. Biol. 18, 1, 1-10 (1941).

T. R. Pfrimmer, "Response of insects to three sources of black light, "Journ. Econ. Entom. 48, 5, 619, (1955).

* See English translation.

THE EFFECT OF IONIZING RADIATION UPON THE DEVELOPMENT OF THE MALLOW MOTH

V. V. Vasilyan

Translated from Éntomologicheskoe Obozrenie, Vol. 39, No. 3, pp. 599-604, July-September, 1960

In spite of its wide distribution, the mallow moth (Pectinophora malvella Hb.) is subject only to internal quarantine; it is known from all the continents on wild Malvaceae, (Azaryan, 1958; Nikol'skii, 1959), but at the same time it is only in Armenia and in Nakhichevan ASSR (Azaryan, 1958; Nikol'skii, 1959) that it is recognized as a cotton pest. There are data indicating that Pectinophora malvella feeds on cotton plants also in Iran.

This makes it difficult to transport cotton products from these regions into others, because a certain number of insects winter in the seeds and in raw cotton (Babayan, 1958; Tumanyan, 1958; Nikol'skii, 1959).

In the cotton growing regions outside USSR there is another widely distributed pest belonging to the same genus, the cotton moth, Pectinophora gossypiella Saund., known in the literature as the "pink bollworm." This species is absent from the USSR due to the implementation of strict quarantine measures, based on the chemical methods of dis-infestation of cotton products. However, the chemical method of dis-infestation of seeds and of cotton products is often found to be ineffective; it requires complex vacuum installations, is characterized by a low production and is not economical.

As a result of these considerations it became necessary to study the effect of ionizing radiation on the mallow moth.

We think that the dosage and conditions of irradiation obtained for the mallow moth can be applied also in the case of the pink bollworm, as these two pests are very similar to each other both according to their systematic position and their mode of life (Lomakina, 1958; Nikol'skii, 1959).

This work was commenced in 1958. Last-stage caterpillars were collected in cotton fields of the Artashat district in the Armenian SSR during the periods of development of the first and the second generations. The collected material was taken to the laboratory, and the caterpillars were irradiated a few days later.

The irradiation of the test material was made in the Biophysics Laboratory of the Institute of Physiology of the Academy of Sciences of the Armenian SSR, and observations on the development of the moths were made in the Department of Plant Protection of the Institute of Agriculture of the Ministry of Agriculture of the Armenian SSR.

All kinds of ionizing radiations have a similar biological effect and we decided to use x-rays, since the production of x-rays does not require complex installations, and they are safer to work with (Buschland and Hopkins, 1953; Shashlov, 1959).

Irradiations were made with an X-ray machine of the type RUM-11 under the following conditions: a load of 180 kv, a current of 10 ma, focal distance of 13 cm both with a copper filter 0.5 mm thick and without a filter; Table 1 gives the magnitude of doses (R) and the periods of irradiation.

Irradiation was made in Petri dishes at a temperature of 18-20°C.

Second generation caterpillars, collected in the autumn of 1958, were kept under natural conditions until May, 1959, and were irradiated in the beginning of May, while they were still in the wintering cocoons. Summer generation caterpillars, collected during July-August 1959, were kept under laboratory conditions; some of them were irradiated in the beginning of August when they were in the last developmental stage, and others were irradiated two or three days after pupation.

Certain observations were made on the irradiated caterpillars. Moths, which resulted from the irradiated caterpillars, were placed in pairs (female and male), on the day of their emergence, and they were given a daily food supplement in the form of a 3% glucose solution on cotton plugs. Observations were made daily until the moths died. The scheme and the results of these experiments are given in the tables.

Table 2 gives the results of experiments on the wintering generation.

This table shows that there is no apparent difference between equal doses of irradiation with and without filters.

Apparently the total amount of X-rays absorbed by the subject is significant, as in both cases (with and without filters), percentage of dead caterpillars

TABLE 1. Dosage, Magnitude of Dosage (R) and Period of Irradiation.

Doses	Without filter. R = 522 r/min	With filter. R = 222 r/min
1000 r . .	1'55"	4'30"
5000 » . .	9'30"	22'30"
10000 » . .	19'	45'
15000 » . .	28'30"	65'30"

increased with the increase of dosage, and in cases when the dosage was 1000 r, and higher, all the caterpillars died.

It is to be noted that in the control experiments and in cases when the dosage was 1000 and 5000 r the majority of caterpillars died after emergence from cocoons, and did not pupate, while with higher irradiation doses they all died before emerging from the cocoons.

It follows from Table 2, as well, that a dose of 1000 r apparently had no effect on the development of the caterpillars, since the results obtained were almost identical with the controls, viz. in both the cases all the emerged moths were quite normal and had an almost identical egg production.

Starting with a dose of 5000 r and higher, x-rays had a deleterious action. Thus, of the total number of caterpillars irradiated with doses of 5000 r only one of the moths that emerged was apparently normal, while the rest were malformed. These malformed moths died as a rule in 1-3 days after emergence and did not oviposit.

Thus, when wintering caterpillars were irradiated in their cocoons at the beginning of May, doses of 5000 r and higher were lethal to the moths that emerged while doses of 10,000 r and higher killed the caterpillars before they could leave the cocoons.

A certain amount of resistance to ionizing radiations in the experimental doses was noted in the caterpillars and pupae of the summer generations of the mallow moth.

It is quite possible that such results were obtained by us because the irradiation of the wintering caterpillars was done not at the beginning of winter but at the end of spring, and thus we dealt with caterpillars which were weakened after wintering. Further work in this direction should give us more conclusive data.

In irradiating caterpillars and pupae of the summer generation, the results were almost identical in both cases; consequently only the data concerning caterpillars are presented.

It follows from Table 3 that the development of caterpillars in control experiments was better than when the caterpillars were irradiated. Similarly, the percentage of dead caterpillars in diapause and of emerging moths varied according to the dosage of irradiation. Thus, when the percentage of dead caterpillars in the control experiments was 10-11.4%, in irradiation experiments it varied from 22.5 to 77.7%. This proves that x-irradiation has an effect on the caterpillars of the mallow moth, and that the maximum effect is at doses of 10,000 and 15,000 r.

It is known from literature that caterpillars of the mallow moth, which feed on cotton and complete their development during July, do not undergo a diapause (Babayan, 1958). However, in our experiments we have noted caterpillars which went into diapause under the action of X-rays; their number constituted up to 15%, while there were none in diapause in the control experiments.

TABLE 2. Percentage of Caterpillars Dead in Cocoons and of Emerged Moths of the Wintering Generation.

Dosage, in ront.	With or without filter	No. of caterpillars in the experiment	Dead caterpillars				Emerged moths			
			total	%	of these: in cocoons (%)	of these: after leaving cocoons (%)	total	%	of these: normal (%)	of these: malformed (%)
1000	with	55	36	65.5	33.3	66.7	19	34.5	100	0
	without	71	26	36.6	42.3	57.7	45	63.4	100	0
5000	with	80	73	91.3	93.1	6.9	7	8.7	0	100
	without	69	59	84.5	25.4	74.6	10	15.5	10	90
10000	with	69	68	98.5	100	0	1	1.5	0	100
	without	69	69	100	100	0	0	0	0	0
15000	with	70	70	100	100	0	0	0	0	0
	without	71	71	100	100	0	0	0	0	0
Control		70	33	47.1	42.4	57.6	37	52.9	100	0
		70	23	33	26.1	73.9	47	67	100	0

TABLE 3. Percentage of Dead and Diapausing Caterpillars and Emerging Moths of the Summer Generation.

Dosage, in roent.	With or without filter	No. of caterpillars in the experiment	Dead caterpillars				% of caterpillars in diapause	Emerged moths			
			total	%	of these: in caterpillar stage (%)	of these: in pupal stage (%)		total	%	of these: normal (%)	of these: malformed (%)
1000	with	35	22	62.8	63.6	36.4	2.8	12	34.4	100	0
	without	30	8	26.6	50	50	0	22	73.4	95.5	0.5
5000	with	40	19	47.5	68.4	31.6	12.5	16	40	62.4	37.6
	without	40	9	22.5	66.6	33.4	5.0	29	72.5	89	11
10000	with	45	35	77.7	94.3	5.7	9.0	6	13.3	100	0
	without	40	23	57.5	65.2	34.8	15.0	11	27.5	72.7	27.3
15000	with	40	25	62.5	88.0	12.0	15.0	9	22.5	33.3	66.7
	without	40	26	65.0	65.4	34.6	12.5	9	22.5	44.4	55.6
Control		35	4	11.4	100	0	0	31	88.6	100	0
		40	4	10.0	25	75	0	36	90	100	0

TABLE 4. Fecundity of Summer Generation Mallow Moths.

Dosage, in roent.	With or without filter	No. of pairs of moths	Did not oviposit		Number of eggs deposited			Duration of oviposition, (in days)		
			no.	%	min.	max.	mean	min.	max.	mean
1000	with	2	0	0	—	—	132	—	—	—
	without	9	1	11.2	0	304	171	14	26	16
5000	with	5	5	100	0	0	0	—	—	—
	without	13	4	30.8	0	74	30	1	17	9
10000	with	3	0	0	13	52	27	1	9	8
	without	4	3	75	0	0	13	0	0	0
15000	with	0*	—	—	—	—	—	—	—	—
	without	1	1	100	0	0	0	0	0	0
Control		12	0	0	70	391	222	7	24	16
		13	2	15.4	0	359	217	11	31	20

The relative resistance of the summer generation caterpillars of P. malvella was also confirmed by the fact that in all the irradiation experiments moths were obtained, and their number fell sharply with increase of the dosage. In spite of the fact that in the irradiation experiments there was noted a high percentage of externally malformed moths, there were emerging at the same time quite normal ones, which oviposited.

Table 4 shows that moths in the control experiments and in experiments employing a dosage of 1000 r were the most prolific. In other irradiation experiments the egg-laying capacity of the moths was sharply decreased.

A dosage of 5000 r using the filter gave 100% sterile moths, while without a filter only 9 females out of the 13 pairs of moths obtained, oviposited. The average egg production in this case constituted only 30 eggs, which is about 7 times less than in the control experiment.

With a dose of 10,000 r using a filter all the moths were fertile, but the average egg production was also about 7 times smaller than in the controls, while without a filter only one pair out of four laid a mere 13 eggs.

In the experiment using a dosage of 15,000 r with a filter, not a single female was obtained (the males were present), and with a filter there was only one pair, and the female did not oviposit.

These data show that X rays in doses of 5000 r and higher have a definite effect on the fecundity of the moths. It is to be noted that when the pupae are

irradiated, the maximal decrease in the moths' fecundity is obtained with doses of 5000 r.

No apparent difference was noted between the longevity of irradiated and non-irradiated moths.

SUMMARY

X rays, in the doses investigated, have different effects on the different generations of the mallow moth

1. When wintering caterpillars in cocoons are irradiated in doses of 10,000 r and higher at the beginning of May, they are all killed before they leave the cocoons. A dosage of 5000 r also in effect completely kills the caterpillars, as the moths obtained from them are externally malformed, and they die in 1-3 days after emergence, without oviposition.

2. Last-stage caterpillars of the summer generation were found to be relatively resistant to X rays. Doses of 5000 r and higher sharply decreases the fecundity of the moths or render them completely sterile.

3. Doses of 10,000 r and higher are maximally lethal to the caterpillars.

4. In irradiation experiments with summer generation caterpillars feeding on cotton, there were up to 15% which went into diapause.

5. A dosage of 1000 r had almost no effect on the development of the mallow moth.

6. No difference was noted between the effects of irradiation of last-stage caterpillars and summer generation pupae.

7. The above-mentioned doses had no apparent effect on the longevity of the moths.

LITERATURE CITED

G. Kh. Azaryan, "Mallow moth on cotton in the Arm. SSR," Trudy. Inst. of Agr. Min, of Agr. Arm. SSR 1, 5-20 (1958).

A. S. Babayan, "Biological peculiarities of Pectinophora malvella Hb. on cotton," Trudy Inst. of Agr. Min. of Agr. Arm. SSR 1, 21-48 (1958).

M. I. Lomakina, "The identification of caterpillars of Pectinophora malvella Hb. and of other related caterpillars developing on cotton," Trudy Inst. of Agr. Min. of Agr. Arm. SSR, 1, 49-68 (1958).

V. V. Nikol'skii, "The Mallow Moth, a Cotton Pest,"(1959).

E. G. Tumanyan, "Means of distribution of the mallow moth and methods of its discovery on cotton," Trudy Inst. of Agr. Min. of Agr. Arm. SSR 1, 105-116 (1958).

V. I. Shashlov, "X rays,"(1959).

A. C. Buschland, and L. E. Hopkins "Sterilization of screw-worm flies with X rays and gamma rays." Econ. Entom. 46, 4 (1953).

BIOLOGY OF PHYLLOXERA AND METHODS FOR ITS CONTROL

Ya. I. Prints

Institute of Biology of Moldavian Branch of the Academy of Sciences, AN USSR, Kishinev

Translated from Éntomologicheskoe Obozrenie, Vol. 39, No. 3, pp. 605-609, July-September, 1960

In view of the great plans for the planting of new vineyards during the seven-year plan (1,120,000 ha* as compared with 775 000 ha on Jan 1, 1960), the question of the control of phylloxera in the regions infested by it – Moldavia, the Ukraine, Georgia, and parts of Azerbaijan and Armenia – has again become a very pressing one.

The phylloxera control problem is particularly acute in Moldavia and in the Ukraine, where 80% of all the vineyards consist of low-quality hybrids, direct producers, which cannot be planted any more, and which must be replaced by high-quality European varieties.

In fact, in Moldavia the whole vine-growing industry has to be almost completely built up anew, since the existing European plantings are restricted to a very small area – 37,000 ha of grafted and 11,000 ha of self-rooted vines. During the seven-year plan it is intended to plant 200,000 ha of European varieties, and to replace 150,000 ha of hybrids between 1966 and 1970, so that by 1970 there will be about 400,000 ha of European varieties in Moldavia.

What questions of phylloxera control are most pressing at present and what are the problems which have received least study?

The main problems are those of chemical control of the root form, questions of phylloxera-resistance and the breeding of resistant varieties, immune vines and, of course, high-quality high-yield varieties of vine with a combined resistance to phylloxera, mildew, Oidium and Botrytis cinerea, as well as frost-hardy and drought-hardy varieties.

So far as the biology of phylloxera is concerned, it has been studied very much better than the above questions. As regards the biology and physiology of phylloxera we must note the interesting works conducted within the last 40 years by Börner and his school in Naumburg on the isolation of subspecies and eight biotypes of phylloxera. The result of this study has led to the breeding of rootstocks immune to both subspecies and the eight biotypes, and this will be of great practical value both as regards arresting the spread of phylloxera, and the freeing of entire regions from phylloxera and the possibility of returning to self-rooted vines of European varieties. This would be of even greater value if it was found that phylloxera alone is the vector of viruses on grafted vines, as some investigators in Western Europe think.

Unfortunately, this is probably not the case. Within recent years there has been appearing more and more evidence that the vectors of viruses which cause infections degeneration of grafted vines are nematodes. That nematodes transmit viruses has been experimentally demonstrated, for instance, in West Germany, in Freiburg (Ochs and Getz). If it is conclusively proved that the virus vectors are nematodes or nematodes and phylloxera, then it will be necessary to return exclusively to self-rooted crops with soil fumigation.

A second, comparatively recently noted feature of the biology of phylloxera is that the process of food specialization, i.e., the reduction in its number of food plants, is a process which is continuing. I have in mind the change in chemotaxis in the two subspecies and all the biotypes of phylloxera as a result of feeding on the roots of European vines. Thus, I established over a 30-year period that in Azerbaijan the two subspecies of phylloxera, as a result of 45 years of food specialization (300 generations) on Caucasian vines, no longer feed either on the roots or on the leaves of American species, or their hybrids, or on hybrids between European and American vines [1958].

This same phenomenon has been observed in recent years in South America and in Western Europe, but was not understood.

The theory of phylloxera resistance of the vine has been well advanced. At present we have a fairly adquately based anatomical and microchemical explanation of susceptibility and resistance of vines to phylloxera, and methods have been devised for determining the phylloxera resistance of resistant and susceptible varieties. The theory of gall-formation has been almost fully worked out. The changes in chemotaxis, which govern the different behavior of phylloxera biotypes, still remain obscure. As regards the life cycle of phylloxera, no changes have yet been

*ha is an abbreviation for hectare.

noted after 100 years of its multiplication in Europe.

Though phylloxera, in its 45 years in Transcaucasia, where it has spread from west Georgia through Armenia into Azerbaijan, has both changed its chemotaxis and lost the ability to feed on American species and their hybrids and on European-American hybrids, there has been no change in its developmental cycle.

The root form develops parthenogenetically on European vines from year to year and in summer produces nymphs, winged forms, sexual forms, and winter eggs which give rise to fundatrices. The changes which have taken place are purely of a physiological character, i.e., under the chemical action of the European vine it has lost the ability to feed on American vines.

We could have used this phenomenon to clear Azerbaijan of phylloxera by means of resistant rootstocks if there had been no risk of introducing a more aggressive form of phylloxera from Georgia, which unfortunately has already occurred in Azerbaijan: in 1956 galls were found on the leaves and roots of the vine variety Riparia X Rupestris 3309. Our investigations showed that in this case there had again been introduced a phylloxera from Armenia which fed continuously on American rootstocks.

It is quite incomprehensible why S. M. Fedorov [1959] has again come out with completely unfounded "new" information on the life cycle of phylloxera.

The lack of foundation of Dedorov's assertions had already been pointed out by Aleksidze, Kazas, and Prints [1948], and by Dalmasso at the international congress in Chili in 1956. If Fedorov had not drawn practical conclusions from his theories and had not cast doubt on the quarantine measures and phylloxera control measures which have been effectively applied for decades, we might not have reacted to his opinions. But this, unfortunately, was not the case.

I will not dwell on all of Fedorov's views, but only on those of cardinal significance.

The first of his viewpoints- that the wingless parthenogenetic females both on roots and on leaves differ in their potential fecundity (great fecundity in spring and a gradual fall in fecundity towards autumn; inevitable transformation to nymphs) – does not correspond with the facts.

The fecundity of the parthenogenetic females of both the root and leaf form depends firstly on the feeding of the phylloxera, i.e., on the quality of the food, and secondly on the temperature, and may vary between 1 to 200 eggs in the root form and 1 to 2500 eggs in the leaf form.

Transformation into the nymphs also depends on the food and temperature. There is a voluminous literature on this question (Grassi, Börner, Prints, Aleksidze, Larchenko). The mere fact that phylloxera does not produce nymphs in soil deeper than 65 cm owing to the temperature indicates that phylloxera can live parthenogenetically in deep layers of soil for tens of years. Fedorov's experiments in tubes, where all the root larvae produced nymphs, only bear out the generally accepted view that nymphs are produced when the feeding conditions deteriorate. The production of winged forms when the feeding conditions deteriorate is a widely known phenomenon peculiar to all aphids.

Phylloxera arrived in Azerbaijan after it had developed parthenogenetically for 40 years on Caucasian varieties of Vitis vinifera in Georgia and Armenia, and in Azerbaijan it has been developing parthenogenetically since 1917, i.e., for 42 years; thus, phylloxera has been developing already for 82 years, giving 7 generations annually, i.e., 574 generations in all. If Fedorov's claim that parthenogenesis of the root form "lasts for only one season" is correct, then there would be no phylloxera problem, since on European vines the fundatrices, which, moreover, are found only as solitary specimens, could give no progeny.

Fedorov's second opinion – that fundatrices emerge in summer and autumn from the winter eggs and winter in the roots – is completely erroneous. This contradicts all the experimental results both of foreign (Grassi, Börner) and Soviet (Prints, Aleksidze, etc.) authors. It is well known that the fundatrix emerging in May from the winter egg does not form galls on European leaves, and since, despite Fedorov's claims, it does not descend to the roots, then it cannot cause infestation when the winged form gets on to European vines. These assertions of Fedorov complicate even more the already difficult problem of quarantine.

According to Fedorov, the larva which emerges from the winter egg can settle both on the leaves and on the roots on all species of the genus Vitis, and it is clear from Fedorov's figure that the root forms pass freely on to the leaves and, conversely, the leaf forms on to the roots.

Holding these views Fedorov cannot explain why in Azerbaijan no one has succeeded and in general, apart from Fedorov, no one has ever succeeded in observing galls in a vineyard where only European vines are present and there are no American or European-American hybrids in the vicinity. His whole section "Biology and Cycle of Development" is an invention. Galls can be found on European varieties only if galls on American vines occur alongside, and from which the leaf form gets onto the leaves of the European vines; it is quite useless for Fedorov to seek confirmation of his views from Aleksidze, who worked in Kakhetiya on a mixed planting (i.e., European and American varieties together), since Aleksidze nowhere states that the fundatrix forms May galls on European vines.

From the section "Biology and Cycle of Development" Fedorov draws the following conclusions, which are completely unfounded and inapplicable for practice.

1)"a single winged form causes infestation, since its progeny may contain both sexes – male and female"; 2)"winged forms are dangerous both in vineyards with American varieties and in vineyards with European varieties, since they can produce the sexual form on the latter also, and hence infest them."

These two points can be united into one. This common point will be true insofar as the winged form may cause infestation on American vines, but it is not true in its main implication, i.e., that the winged form can cause infestation on European vines too. The European vine can be infested either by the root form from the root of American or European bushes, or by the root form produced in the leaf galls on American vines or on European-American hybrids.

3) "Phylloxera on the roots develop parthenogenetically only in the course of one season and inevitably gives nymphs, winged and sexual forms both on American and European varieties."

I have already mentioned above that if this were so, there would be no phylloxera problem, since all the nymphs would leave the soil, and we find very few winter eggs. But Fedorov tries to extricate himself from this difficulty and conjures up the notion that:

4) "the egg of the sexual form cannot winter, as happens sometimes in the south, but produces a fundatrix in summer, and more often in autumn. The latter overwinter on the roots, and in spring produces several parthenogenetic generations both on the roots, and on the leaves."

Such a theory could only have been advanced by a man who had never made diggings in a vineyard and who had constructed his whole new biology of phylloxera on what he had observed in a test tube; on the dried-up root the larvae of the root form changed into nymphs.

While a fairly abundant production of nymphs is sometimes observed on some resistant American vines, this is never observed on European vines; moreover, no one has yet succeeded in finding sexual forms or their eggs in the soil or on the roots.

I will not dwell on the section "Phylloxera-resistance and its causes." The author has no understanding of these questions either, but he does not attempt to draw any conclusions. As regards control methods, Fedorov, proceeding from his "new biology," makes the same mistakes in this question also.

How can we now make proper use of the biology of phylloxera and the phylloxera-resistance of the vine to organize control measures?

The biology of phylloxera and the developmental cycle of phylloxera have been very correctly and accurately studied in Western Europe. During the post-revolution period these results were completely confirmed in our country, and hence the "new biology and cycle of development" of Fedorov and Nikolaev are a very regrettable page in our literature on phylloxera.

As regards phylloxera-resistance the theory of resistance of the vine has been well worked out and methods have been devised for determining phylloxera-resistance; the changes in the chemotaxes of the two subspecies and the biotypes of phylloxera are still an obscure feature.

Rootstocks immune to both the root and leaf phylloxera have been bred (Börner – Naumburg, GDR), and we have confirmed their immunity in Moldavia.

It will now be possible to grow a grafted crop on immune rootstocks and to rid entire regions of phylloxera with the aid of chemical extermination methods which do not destroy the bush; this has now become possible by the application of new fumigants – hexachlorobutadiene and tetracholoropropane. In the case of fumigation with hexachlorobutadiene, which is active in the soil for two years, it will not be necessary to carry out any additional measures even in nurseries, since there will be no nymphs, and hence no winter eggs or leaf forms.

No badigeonnage, i.e., treatment of the basal part of the bush, will be necessary, as Fedorov proposes. If it is confirmed that the vectors of viruses causing infectious degeneration of the plants are nematodes, then the future of viticulture lies with self-rooted crops and soil fumigation, since it is hardly likely that varieties of vine immune to nematodes can be bred.

Moldavia is taking the path of large-scale planting of self-rooted vineyards in view of the development of cheap chemical methods of combating phylloxera with new fumigants.

Besides improving chemical control it will be necessary to advance our knowledge of phylloxera-immunity in the vine, and to breed high-quality varieties with combined resistance to phylloxera, mites and fungi – mildew, Oidium and Botrytis.

LITERATURE CITED

Ya. I. Prints, Zool. Zhur. 37, 4, 523-530 (1958).

S. M. Fedorov, Entomol. obozr. 38, 1, 82-97 (1959).

S. M. Fedorov, Viticulture and Wine-Making in the USSR [in Russian] (1947).

Aleksidze, Kazas and Prints, Viticulture and Wine-Making in the USSR [in Russian] (1948).

ACRIDIDAE (ORTHOPTERA) OF SINKIANG

E. P. Tsyplenkov

All-Union Institute of Plant Protection, VASKhNIL, Leningrad
Translated from Éntomologicheskoe Obozrenie, Vol. 39, No. 3, pp. 610-616, July-September, 1960

The present work is devoted to the Acrididae collected by the Soviet antilocust expeditions to Sinkiang Province (Northwest China) in 1954 and 1955.

The following list of grasshoppers in the fauna of Sinkiang should not be considered exhaustive and the work itself is by no means a summary of all the literature on this subject. However, the material presented is of interest both for broadening our knowledge of the grasshoppers of Northwest China and for constructing a rational system of control measures against harmful locusts in various sections of the eastern Union republics bordering the province of Sinkiang. It is enough to point out that of the 64 species of grasshoppers we collected 19 are serious agricultural pests, one belongs to a new genus only described in 1956, and on 40 species there are no literature data indicating their presence in the territory of West China.

The province of Sinkiang is situated between 34° 30' and 49° N. lat. and 73°30' and 96°30' E long. It is surrounded on the north, west, and south by the mountain ranges of the Altai, Tarbagatai, Tien Shan, Pamir, Karakorum, and Kunlun. On the east, where the deserts of Mongolia encroach on Sinkiang, there are no high mountains. The Tien Shan mountain range divides Sinkiang into two parts; northern and southern: Dzhungaria and Kashgaria.

Orographically Dzhungaria and Kashgaria are very similar, being relatively extensive basins, somewhat drawn out in a latitudinal direction, and bordered on almost all sides by mountains. The central part of the basins is occupied by waterless sandy deserts almost devoid of vegetation. Along the periphery of the sandy deserts there are saline deserts and semideserts which, as one proceeds further from the basin center towards the mountain ranges, become replaced by sand and stone deserts and semideserts, these in turn gradually merging into foothills and mountains.

Inherent to each of the above edaphic-geographical zones are characteristic landscapes, which were described at one time by M. G. Popov (1931). On the basis of its phytogeographical complexes Popov ascribes Kashgaria and the desert part of Dzhungaria to a separate section of the Archaic-Mediterranean region, while the mountainous part of Dzhungaria is ascribed to the boreal subregion of the Ginkgo region.

The climate of Sinkiang is dry and acutely continental; hydrologically this province belongs to the regions without drainage.

The principal field of economic activity in Sinkiang is agriculture, especially livestock raising and field crops; livestock raising predominates on the northern regions, while field crops predominate in the central and southern regions. The majority of agricultural crops are grown in irrigated land.

Collection of the grasshoppers listed below took place largely within the area of Sinkiang (see map). They were carried out from May to September during the process of conducting operational measures against locusts and during special excursions. The secretary of the Department of Agriculture of Sinkiang Province, comrade Feng Ch'ao-k'ung, always took an active part in the organization of the excursions, for which we must extend him our sincere thanks. All the entomologists of the expedition took part in the collecting

For economy of space and to avoid repetition the following conventional symbols have been used in the list of grasshoppers: D – Dzhungaria; K – Kashgaria; in case the grasshopper was not collected by the author, the last name of the collector is given in parentheses after the data on the number of specimens; the number of individuals is recorded only if fewer than 10 specimens were collected; a plus indicates that there are literature records of the presence of the given grasshopper in the area of Sinkiang; a minus indicates that such literature records are absent; an asterisk (*) indicates that the given species injures agricultural crops to some extent; a number sign (#) indicates that we did not record any agricultural injury.

I. Subfam. CATANTOPINAE

1) Dericorys tibialis Pall. D: between the mountain ranges of Maili and Dzhaira, semidesert plain, Chuguchak-Kobuk road, August 3, 1954 (1♀), —, #.

2) D. annulata roseipennis Redt. D: environs of Kobuk, semidesert plain, Aug. 3, 1954 (2♀♀); 8 km SW of Suidun, semidesert plain, Aug. 31, 1955 (1 ♀; Shcherbakov), + , *.

3) Calliptamus turanicus Tarb. D: Mongolian Altai, mostly on southern mountain slopes with scattered mixed grasses, 40 km east of Shara-Sumé, about 1500

m alt., Aug. 10, 1954, +, *. K: Turfan Basin, three-year deposit overgrown with herbs, June 30, 1954 (2♀♀), –, *.

4) C. italicus italicus L. D: Emel' River valley, sand and stone and saline semidesert, Aug. 1, 1954; semidesert plain between Maili and Dzhaira ranges, Chuguchan-Kobuk road, Aug. 3, 1954; environs of Shara-Sumé, Aug. 8, 1954; environs of Kul'dzha, Aug. 29, 1955 (Shcherbakov); W. shore of L. Ebi-Nor, Aug. 25, 1955; environs of Shikho, July 22, 1954; edge of Sandzhi, June 15, 1955; 3 km E of Fukan, sand and stone piedmont semidesert, July 6, 1955; environs of Guchen, June 26, 1955; Barkul Basin, June 26. 1954 – *. K: environs of Khami, June 28, 1954, –, *. Some years, when it reproduces in large numbers, it flies into USSR territory.

5) C. barbarus barbarus Costa. D: semidesert plain between Maili and Dzhaira ranges, Chuguchak–Kobuk road, Aug. 3, 1954 (1♀); environs of Shara-Sumé, Aug. 8, 1954 (1 ♀); environs of Kul'dzha, Aug. 28, 1955 (1 ♀, 2♂♂; Shcherbakov); Fukan district, sand and stone piedmont desert, July 7, 1955; environs of Guchen, June 26, 1955; Barkul Basin, June 27, 1954, – #. K: environs of Khami, June 28, 1954; Turfan Basin, June 30, 1954; environs of Ak-Su, left bank of Ak-Su R., July 26, 1955 (2♀); 25 km west of Ak-Su, Urumchi-Kashgar road, July 26, 1955 (1 ♀), –, *.

6) Metromerus coelesyriensis coelesyriensis G.–T. D: Barkul Basin, sand and stone piedmont semidesert, June 27, 1954 (1♀) and Aug. 5, 1955 (3 ♀♀, 3♂♂; Krupchinskii), –, #.

7) Thisoicetrus littoralis littoralis Ramb. K: environs of Khami, June 28, 1954 (3 ♀♀, 3♂♂), –, #.

II. Subfam. PYRGOMORPHINAE

8) Pyrgomorpha conica mongolica Sjöst. K: Environs of Khami, among wheat plantings, June 24, 1955 (6 ♀♀, 5♂♂); suburbs of Charklyk, Aug. 26, 1954 (1 ♂), –, #.

9) Chrotogonus turanicus Kuthy. K: environs of Charklyk, Aug, 26, 1954 (1♂), –, #.

III. Subfam. PAMPHAGINAE

10) Asiotmethis zacharjini B.-Bienko. D: Emel' R. valley, semidesert piedmont of Barlyk, Chogan-Tugai district, July 31, 1954 (2♀♀, 3 ♂♂); Black Irtysh R. valley, 40 km north of Burchum, Aug. 6, 1954 (1 ♂), +, #.

11) Beybienkia somgorica Tsypl. D: Barkul Basin, June 26, 1954 (1♀, 1♂), +, #. K: S slopes of the Barkul'-Tag range on Turfan-Khami road, June 24, 1954 (2 ♂♂), +, #.

IV. Subfam. EGNATIINAE

12) Egnatius apicalis Stal. D: W slopes of the mongolian Altai, sand and stone piedmont semidesert Shara-Sumé – Guchen road, Aug. 14, 1954 (1♂); Barkul' Basin, June 27, 1954 (1 ♂), +, #.

V. Subfam. ACRIDINAE

13) Acrida oxycephala Pall. D: environs of Kul'dzha, Aug. 28, 1956 (1♀, 1♂; Shcherbakov), +, #.

14) Duroniella gracilis Uv. K: environs of Khami, wheat plantings, June 24, 1955 (4♀♀); Turfan Basin, wheat plantings, June 30, 1954, (4 ♀♀, 2 ♂♂); suburbs of Pichan, June 24, 1954 (6 ♀♀, 4♂♂); environs of Lob, Aug. 6, 1955 (1 ♀), –, #.

15) Chrysochraon dispar dispar Germ. f. macroptera. K: environs of Khami, Aug. 12, 1955 (1♀; Krupchinskii, –, #.

16) Arcyptera fusca fusca Pall. D: piedmont of Tarbagatai, 5 km NW of Chuguchak, June 6, 1954 (2 ♀♀, 2 ♂♂); Black Irtysh R. valley, 10 km north of Burchun, Aug. 8, 1954 (2♀♀, 3 ♂♂); piedmont of the Mongolian Altai, 40 km NE of Shara-Sumé, Aug. 10, 1954 (3 ♀♀, 2 ♂♂), –, *.

17) Pararcyptera microptera altaica Mishch. Intermediate form between this subspecies and P. microptera microptera F. –W., but nevertheless closer to the former. D: mountains of the Mongolian Altai, steppe zone, Kok-Togoi district, Aug. 12, 1954 (1 ♀ 1 ♂), +, *.

18) Ramburiella turcomana F.– W. D: mountains of the Mongolian Altai, grassy steppe zone, 40 km east of Shara-Sumé, Aug. 10, 1954 (1♀); environs of Kok-Togoi, Aug. 12, 1954 (1♂); suburbs of Sandzhi, June 4, 1954 (4 ♀♀), –, *.

19) Dociostaurus (s. str.) brevicollis Ev. D: environs of Kul'-dzha, Aug. 9 (1♀; Shcherbakov), –, *.

20) D. tartarus Uv. D: SE/outskirts of Kul'dzha, Aug. 28, 1955 (1 ♀; Shcherbakov); environs of Manas, July 22, 1954 (1 ♂), –, *.

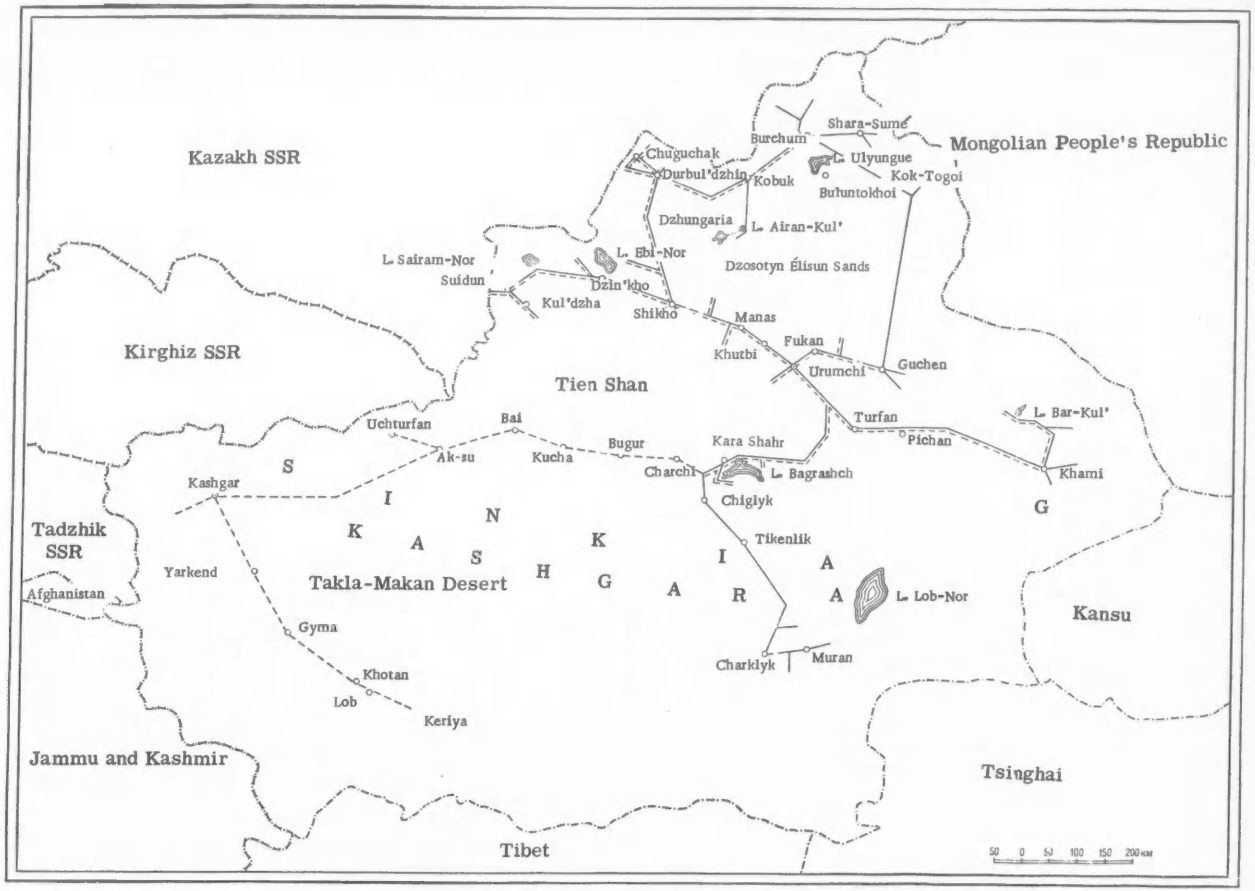
21) D. (Stauronotulus) kraussi kraussi Ingen. D: Mongolian Altai, semidesert piedmont, 40 km east of Shara-Sumé, Aug. 10, 1954; environs of Burchum, Aug. 6, 1954; suburbs of Kok-Togoi, Aug. 12, 1954; Émel' R. Valley, sand and stone grassy semidesserts in the Chuguchak, Chogan-Tugai, and Mopan districts, June 13, 1954; environs of Shikho, July 21, 1954, Manas, June 4, 1954, Sandzhi, June 4, 1954, Urumchi, June 3, 1954, Fukan, June 26, 1955, Guchen, June 27, 1955; Barkul' Basin, June 27, 1954, –, *. K: environs of Khami, June 28, 1954, –, *.

22) D. (S.) kraussi nigrogeniculatus Tarb. D: N slope of the Tien Shan, Sandzhi district, sand and stone semidesert piedmont, June 2, 1955, –, #.

23) Notostaurus albicornis albicornis Ev. D: Mongolian Altai, 40 km east of Shara-Sumé, Aug. 10, 1954 (2 ♂♂); environs of Manas, July 22, 1954 (1 ♂), –, #.

24) Eremippus simplex simplex Ev. D: environs of Burchum, July 6, 1954 (2 ♀♀), –, #. K: NW outskirts of Charklyk, Aug. 26, 1954 (1 ♂), –, #.

25) E. miramae Tarb. D: SE outskirts of Kul'dzha, Aug. 28, 1955 (3 ♀♀; Shcherbakov), +, #.



1 2 3 4 5 6

Schematic map of routes in Sinkiang along which grasshopper collections were made.

Borders: 1- National; 2- USSR Union republican; 3- Chinese provincial. Principal routes: 4- 1954 and 1955; 5- 1954; 6- 1955.

26) Mecostethus grossus L. D: Mongolian Altai, grassy steppe zone, 40 km east of Shara-Sumé, Aug. 10, 1954; Barkul' Basin, June. 26, 1954, –, *.

27) Parapleurus alliaceus turanicus Tarb. D: SW shore of L. Ébi-Nor, Aug. 25, 1955 (2 ♀♀, 3 ♂♂), –, #.

28) Stenobothrus eurasius eurasius Zub. D: Barkul' Basin, mountain meadows, June 26, 1954, –, *.

29) S. fisceri Ev. D: Mongolian Altai, grassy steppes, suburbs of Kok-Togoi, Aug. 12, 1954 (2 ♀♀, 3 ♂♂), –, *.

30) Omocestus ventralis Zett. D: barkul' Basin, mountain meadows, June 27, 1954 (4 ♀♀, 5 ♂♂), –,

31) Myrmeleotettix palpalis Zub. D: Barkul' Basin, mountain meadows, June 26, 1954, –, #.

32) Gomphocerus sibiricus sibiricus L. D: Barkul' Basin, mountain meadows and forest edge, alt. 1000 to 2500 m, June 25, 1954, –, *.

33) Mesasippus kozhevnikovi robustus Mishch. K: 3 km east of Khami, wheat plantings, June 24, 1954, (3 ♂♂), +, #.

34) Stauroderus scalaris scalaris F. –W. D: environs of Kok-Togoi, Aug. 12, 1954 (2 ♂♂), –, *.

35) Chorthippus apricarius apricarius L. D: Mongolian Altai, 40 km east of Shara-Sumé, Aug. 10. 1954 (3 ♂♂); Barkul'Basin, mountain meadows, June 26, 1954 (1♀), –, #.

36) Ch. biguttulus meridionalis Misch. D: 40 km east of Durbul'dzhin, semidesert piedmont plain, Aug. 2, 1954 (2 ♀♀, 2 ♂♂), –, #.

37) Ch. mollis mollis Charp. D: SE outskirts of Kul'dzhi, Aug. 28, 1955 (4 ♀♀, 4 ♂♂; Shcherbakov), –, #.

38) Ch. dichrous Ev. D: Mongolian Altai, 40 km east of Shara-Sumé, mountain meadows, Aug. 10, 1954 (2 ♀♀, 3 ♂♂), –, #.

39) Ch. albomarginatus albomarginatus De G. D: Barkul'Basin, mountain meadows, June 26, 1954 (7♀♀, 6 ♂♂), –, *.

VI. Subfam. OEDIPODINAE

40) Epacromius coerulipes Ivan. D: Borotala R. valley, 20 km west of L. Ebi-Nor, Aug. 25, 1955 (3♀♀, 2 ♂♂), +, #.

41) E. tergestinus tergestinus Charp. D: 20 km north of Burchum, Aug. 8, 1954; environs of Kul'dzha, Aug. 30, 1955 (Shcherbakov); 15 km west of L. Ebi-Nor, along right bank of Borotala R., Aug, 25, 1955; environs of Sandzhi, July 6, 1955; environs of Fukan, July 7, 1955; suburbs of Guchen, June 26, 1955 (3♀♀, 1 ♂; Lebedev), +, *. K: environs of Khami, June 26, 1954; shore of L. Bargash-Kul', near inlet of Khaidyk-Gol R., Aug. 20, 1955; environs of Kucha, Aug. 23, 1955; 60 km west of Kucha, Urumchi – Kashgar road, July 23, 1955 (3 ♀♀, 1 ♂); 20 km west of Bai, Urumchi – Kashgar road, July 25, 1955 (2 ♀♀, 2, ♂♂); left bank of Ak-Su R., environs of Ak-Su, July 26, 1955; environs of Yarkend, Aug. 4, 1956; suburbs of Lob, Aug. 6, 1955, NW outskirts of Charklyk, Aug. 26, 1954 (7 ♀♀, 4 ♂♂), +, *.

42) Hilethera maculata Karny. K: 3 km east of Khami, sand and stone piedmont, semidesert, June 24, 1954 (2 ♀♀), –, #.

43) Locusta migratoria migratoria L. D: 10 km downstream from Shara-Sumé on R. Kran, Aug. 10, 1954; confluence of Kran and Black Irtysh, Aug. 7, 1954; NW shore of L. Ulyungur-Nor, Aug. 12, 1954; N shore of L. Airan-Kul', inlet of Pinyan-Khe (Dyam) R., Aug. 3, 1954; Emel' R. valley, confluence of Émel' and Ak-Su, Aug. 1, 1954; Borotala R. valley Aug. 25, 1955; environs of Shikho, July 4, 1954, Manas, July 5, 1954, Sandzhi, July 5, 1954, and Guchen, Aug. 14, 1954, +, *. K: environs of Khami, wheat, sorghum, and corn plantings, June 28, 1954; Turfan Basin, June 30, 1954; W shore of L. Bargash-Kul', Aug. 22, 1954; environs of Kurlya, Aug. 23, 1954; environs of Tikenlik, Aug. 25, 1954; 5 km NW of Charklyk, Aug. 26, 1954; N outskirts of Muran, Aug. 27, 1954; shore of L. Lob-Nor 60 km NNE of Charklyk, Aug. 29, 1954; 60 km south of Kucha, July 23, 1955; 30 km west of Ak-Su, July 26, 1955; environs of Uch-Turfan, July 28, 1955; 40 km S of Kashgar, Landmark of Ak-Tu, Aug. 2, 1955; environs of Yarkend, Aug. 4, 1955; environs of Khotan, Aug. 6, 1955; suburbs of Lob, Aug. 7, 1955; 150 km ESE of Khotan, Khotan-Keriya road, Aug. 8, 1955, +, *. During outbreak years it may fly into the Soviet Union along the valleys of the Ili, Émel', and Black Irtysh rivers and across the Dzhungarian passes. It was noted that in the environs of Khami and in the Turfan Basin the Asiatic locust has two complete generations in some years.

44) Oedaleus decorus Germ. D: valley between Maili and Dzhaira ranges, grassy semidesert, Chuguchak-Kobuk road, Aug. 3, 1954 (2 ♀♀); 100 km SE of Burchum, Burchum-Kok-Togoi road, Aug. 8, 1954 (1 ♀); 40 km SE of Kul'dzhi, Aug. 28, 1955 (2 ♀♀; Shcherbakov); environs of Fukan, July 7, 1955 (1 ♀); Barkul' Basin, June 25, 1954 (3 ♀♀, 3 ♂♂), +, *. K: 4 km NE of Khami, wheat plantings, June 28, 1954 (4♀♀), –, *.

45) Pyrgodera armata F. –W. D: Émel' R. valley 5 km NW of Chuguchak, June 28, 1954 (1♀, 1♂; Starostin), –, #.

46) Celes variabilis variabilis Pall. D: Émel' R. valley, 5 km NE of Chuguchak, July 31, 1954 (1♀, 1♂); environs of Kobuk, Aug. 3, 1954 (1♂; environs of Shara-Sumé, Aug. 10, 1954 (1♂); environs of Kok-Togoi, Aug. 12, 1954 (1 ♂); piedmont of the Mongolian Altai, Kok-Togoi-Guchen road, Aug. 12, 1954 (1♀, 1♂), –, #.

47) Oedipoda coerulescens L. D: 40 km NE of Shara-Sumé, Aug. 10, 1954 (3♀♀, 2♂♂); Kensai

and 1955; 5 - 1954; 6 - 1955.

Pass near L. Sairam-Nor, Kuk'dzha-Urumchi road, Aug. 26, 1955 (2♀♀, 2 ♂♂); environs of Fukan, July 6, 1955 (1♀); left bank of Ili R., 10 km SE of Kul'dzha, Aug. 28, 1955 (5 ♀♀, 2 ♂♂; Shcherbakov), +, #.

48) Oe. miniata miniata Pall. D: 40 km SE of Kul'dzha, Aug. 28, 1955 (1♀), –, #.

49) Bryodema tuberculatum dilutum Stoll. D: Mongolian Altai, piedmont semidesert, 40 km NE of Shara-Sume, Aug, 10, 1954 (2♀♀, 4♂♂); environs of Kok-Togoi, Aug. 12, 1954 (1♀), –, #.

50) B. zaisanicum fallax B.-Bienko; D: Émel' R. valley , 20 km NE of Chuguchak, Aug. 30, 1955 (1♀, 1 ♂), +, #.

51) B. gebleri gebleri F. -W. D: Koby valley, semidesert plain, 10 km west of Kobuk, Aug. 3, 1954 (6♂♂); left bank of Black Irtysh, 15 km east of Burchum, Aug. 7, 1954 (1 ♀, 2 ♂♂); 40 km north of Burchum, Aug. 7, 1954 (1♀, 1♂); Barkul' Basin, June 25, 1954, +, #.

52) B. gebleri mongolicum Zub. D: Barkul' Basin, semidesert, stony foothills, June 26, 1954, +, #.

53) Compsorhipis davidiana Sauss. D: left bank of Black Irtysh, sand and stone semidesert plain, 30 km east of Burchum, Aug. 7, 1954 (6 ♀♀, 5 ♂♂), –, #.

54) Sphingonotus maculatus petraeus B. -Bienko. D: Mongolian Altai, environs of Shara-Sumé, Aug. 10, 1954 (2♀♀); S outskirts of Guchen, July 6, 1955 (1 ♀, 1♂); environs of Fukan, July 7, 1955 (1 ♂), –, K: 3 km NE of Khami, July 28, 1954 (1♂); Agyr-Bulak pass, Toksun-Kobuk road, Aug. 22, 1954 (3 ♂♂), –, #.

55) S. rubescens rubescens Walk. D: between Maili and Dzhaira mountain ranges, semidesert, plain, Chuguchak-Kobuk road, Aug. 3, 1954 (1♂); left bank of Black Irtysh, sand and stone semidesert plain, 30 km east of Burchum, Aug. 7, 1954 (1♀, 1♂), –, #.

56) S. elegans Misch. D: Barkul' basin, June 26, 1954 (1♀), +, #; K: Turfan Basin, June 30, 1954 (2 ♀♀, 2♂♂); Agar-Bulak pass, Toksun-Karashar road, Aug. 22, 1954 (6♀♀); flood plain of the Ak-Su, July 27, 1955 (2 ♀♀, 2 ♂♂); south slopes of the Tien Shan, stony piedmont semidesert, Ak-Su-Uch-Turfan road, July 28, 1955 (1♀), –, #.

57) S. bey-bienkoi Mishch. D: left bank of Black Irtysh, sand and stone semidesert plain, 30 km east of Burchum, Aug. 7, 1954 (6♀♀, 2 ♂♂); environs of Shara-Sumé, Aug. 10, 1954 (1♀); Barkul' Basin, June 26, 1954 (1 ♀, 1 ♂), +, #. K: Agyr-Bulak pass, Toksun Karashar road, Aug. 22, 1954 (1♂); south slopes of the Tien Shan, stony semidesert piedmont, Ak-Su-Uch-Turfan road, Aug. 27, 1955 (1 ♀, 1♂); left bank of the Yarkend-Dar,Ya, 2 km SE of Yarkend, Aug. 4, 1955 (1 ♀), +, #.

58) S. coerulipes uvarovianus B. -Bienko. D: between Maili and Dzhaira ranges, semidesert plain, Chuguchak-Kobuk road, Aug. 3, 1954 (1♂); Mongolian Altai, semidesert plain, Kok-Togoi-Guchen road, Aug. 12, 1954 (1 ♀); Barkul' Basin, June 26, 1954 (2 ♀♀, 1♂), –, #.

59) S. nebulosus nebulosus F. –W. D: between Maili and Dzhaira ranges, semidesert plain, Chuguchak – Kobuk road, Aug. 3, 1954 (1♀); S shore of L. Sairam-Nor, Aug. 26, 1955 (2 ♀♀); environs of Manas, July 22, 1954 (2 ♀♀); S outskirts of Fukan, July 6, 1955 (2 ♀♀); environs of Guchen, June 27, 1955 (4 ♀♀); Barkul' Basin, June 25, 1954 (1 ♀, 2 ♂♂), +, #.

60) S. octofasciatus Serv. D: N. outskirts of Chuguchak, Aug. 28, 1955 (1 ♂); environs of Guchen, June 27, 1955 (2♀♀, 1♂), +, #.

61) S. obscuratus latissimus Uv. K: S slopes of the Tien-shan, stony piedmont semidesert, Ak-Su-Uch-Turfan road, July 28, 1955 (1♀, 1♂); environs of Yarkend, Aug. 4, 1955 (2 ♂♂), –, #.

62) S. salinus Pall. D: left bank of Black Irtysh, saline semidesert, 40 km east of Burchum, Aug. 6, 1954 (1♂); Mongolian Altai, piedmont semidesert plain, Kok-Togoi-Guchen road, Aug. 13, 1954 (1♀, 3 ♂♂); environs of Guchen, Aug. 14, 1954; Barkul' Basin, June 23, 1955 (1 ♀, 2 ♂♂), +, #. K: environs of Khami, June 28, 1954 (1♀), –, #.

63) Sphingoderus carinatus Sauss. D: left bank of the Black Irtysh, sand and stone semidesert, 30 km east of Burchum, Aug. 6, 1954 (1♂); environs of Shara-Sumé, Aug. 10, 1954 (1 ♀, 1♂), +, #. K: E outskirts of Khami, July 28, 1954 (9 ♀♀, 4♂♂); left bank of the Ak-Su, 20 km SW of Ak-Su, July 26, 1955 (1 ♀); flood plain of Yarkend-Dar'ya, environs of Yarkend, Aug. 4, 1955 (1 ♀), +, #.

64) Helioscirtus moseri moseri Sauss. D: sand and stone piedmont desert, 10 km south of Manas, July 22, 1954 (1 ♀, 1♂), +, #. K: stony piedmont semidesert, 40 km NE of Khami, June 28, 1954 (1 ♂), –, #.

This list of grasshoppers of Sinkiang is not final and there is no doubt that it will be supplemented in the future. We might point out that the zone of alpine and subalpine mountain meadows was investigated very little, and the central desert portion was not visited at all.

Most of the grasshoppers inhabiting Sinkiang are typical of the corresponding latitudes of Kazakhstan and Soviet Middle Asia. However, the species Beybienkia songorica Tsypl., Bryodema gebleri mongolicum Zub., Compsorhipis davidiana Sauss., and several others occurring in the east of the province, attest to a connection with the fauna of desert Mongolia and Central Asia. This leads to the conclusion that the border between the grasshopper faunas of western Asia and Central Asia runs along eastern Sinkiang. The endemic Beybienkia songorica Tsypl. is of particular interest in this connection. Being undoubtedly a member of the Filchnerella group (Bei-Bienko, 1948) and having a Central Asian genesis, the genus

Beybienkia Tsyp. is very similar in a number of characteristics to the European and western Asian desert - steppe genus Asiotmethis Uv. This indicates an ancient connection not only between these genera but also between the groups they represent, which, in turn, underlines the historic connection between the desert-steppe fauna of Central Asia and the corresponding fauna of western Asia.

The author is particularly grateful to G. Ya. Bei-Bienko, L. L. Mishchenko, and E. M. Shumakov for assistance in the work and for help in determining several species of grasshoppers.

SUMMARY

The present paper is devoted to the Acrididae collected by the Soviet antilocust expedition to Sinkiang Province (Northwest China) in 1954 and 1955. A total of 64 species belonging to 39 genera and six subfamilies of the family Acrididae were collected (Catantopinae, Pyrgomorphinae, Pamphaginae, Egnatiinae, Acridinae, and Oedipodinae). Of the total number of Acrididae collected 19 species are agricultural pests; with regard to 40 species there were no data in the literature indicating their presence in Northwestern China. The material presented therefore enriches our knowledge of the Acrididae fauna of Sinkiang considerably and can be used in creating a rational system of control measures against injurious Acrididae in some areas of the eastern Union republics bordering Sinkiang. Most of the acridids are typical of the fauna of corresponding latitudes of Kazakhstan and Middle Asia. However, the species Beybienkia songorica Tsypl., Bryodema gebleri mongolicum Lub., Compsorhipis davidiana Sauss, and others occurring in the east of the province show its relationship to the fauna of desert Mongolia and Central Asia. In this connection the endemic Beybienkia songorica Tsypl. is of particular interest. Being a representative of the group Filchnerella (Bei-Bienko, 1948) and having a Central Asiatic genesis, the genus Beybienkia Tsypl. is very similar in several characters to the European and west Asiatic desert-steppe genus Asiotmethis.

The genus Beybienkia Tsypl. has been found in a zone between the boundaries of the areas occupied by the Filchnerella group and the genus Asiotmethis Uv. This indicates the ancient genetic links between the desert-steppe fauna of Central Asia and the corresponding fauna of western Asia.

The list presented of the Acrididae of Sinkiang should not be considered exhaustive, since the zone of alpine and subalpine meadows has not been sufficiently investigated and the central desert portions have not been visited at all.

LITERATURE CITED

G. Ya. Bei-Bienko, "Grasshoppers of the tribe Thrinchini (Orthoptera, Acrididae) collected by Russian travellers in Mongolia and adjoining China," Éntom. Obozr. 30, 3-16 (1948).

G. Ya. Bei-Bienko and L. L. Mishchenko, Grasshoppers of the Fauna of the USSR and Adjoining Countries, pts. 1 and 2 [in Russian], (1951) pp. 1-667.

L. L. Mishchenko, "Grasshoppers (Catantopinae)," Fauna SSSR, Orthoptera VI, 2, 1-610 (1952).

M. G. Popov, "Between Mongolia and Iran," Tr. po prikl. botan., genet. i selekts., 26, 3, 45-84 (1931).

S. P. Tarbinskii, "Contribution to the knowledge of the genus Calliptamus Serv. (Orthoptera, Acrididae)," Izv. AN SSSR, Otd. Fiz.-mat. Nauk, 2, 177-186 (1930).

E. P. Tsyplenkov, "New species of the tribe Thrinchini (Orthoptera, Acrididae) from West China," Éntom. Obozr. 35, 4, 883-885 (1956).

E. P. Tsyplenkov, "Calliptamus turanicus Tarb. in the northeast of Sinkiang Province," Zashch. rast. ot vred. i bolezn. 6, 58 (1957).

Chang Hsüch-tsu, "A preliminary report on the Sinkiang Acrididae with special reference to their egg capsules and distribution," Acta Entomologica Sinica 5, 4, 463-476 (1955).

TRUE BUGS (Heteroptera) OF THE EASTERN SECTOR OF ARCTIC EURASIA

A. N. Kirichenko

Translated from Entomologicheskoe Obozrenie, Vo. 39, No. 3, pp. 617-628, July-September, 1960

On Wrangel I. the true bugs are represented by an insignificant number of species, as we might have expected. Their populations are also very small. Only one species of the order has been found on the island. This is:

Chiloxanthus stellatus Curt. [= borealis (Stal)]. Wrangel I., 17/VII/1936 (Mineav); Rodgers Bay (Portenko).

The only species of the order found at present is on Wrangel I.and iswidely distributed throughout the arctic zone of Eurasia. So far the species has been recorded from the following localities (asterisks indicate localities published for the first time): Central Lapland, mountains of northern Norway (Saltdalen, Vadsö), shores of Varanger Fiord; *Iokanga in the eastern part of the Murman Coast, 14, 16, 19, 22/VII/1926 (Kapustin); Rybnaya and C. Mikulkin, on *Kanin Pen.; Peschanki on the eastern extremity of the Timan Coast, 22/VIII/1905 (Zhuravskii); *Bol'shezemel'skaya tundra, 10 versts north of Mt. B. Savai-Bei on Pai-Khoi Range, 21-31/VII/1908 (Kertselli); *Kara tundra, R. Pyderata, R. Khuuta, tributaries of the Kara, lower reaches of Kara, the Bolshaya and Malaya Vanuita rivers; *R. Shchuch'ya, a left tributary of the Ob, 13/VI/1928 (Samko); *south island of Novaya Zemlya, C. Karmakuly and R. Noguev; *Matochkin Shar, 18 and 19/VII/1925 (Vakulenko), very numerous; Dudinka on the lower Yenisei; Nikandrov I. in Yenisei Gulf; *Taimyr, upper reaches of R. Taimyr, station No. 27, 10/VII/1929 (Tolmachev); *R Yamutarida, 9/VIII/1929 (Tolmachev); *opposite mouth of R. Depta, tributary of Taimyr, 12/VII/1929 (Makar'in); *Korennoi I. in Khatanga Gulf near mouth of R. B. Balakhna, 15 and 16/VII/1933 (Yakovlev); *Yana, 50 versts below Verkhoyansk, 31/V, 5 and 6/VI/1927 (Tkachenko); *Khatygnakh on R. Dulgalakh, left tributary of Yanna, 15/V/1927 (Nikiforov); *Tobolakh, R. Adycha system, right tributary of Yana, 20/VI/1927 (Tkachenko); *L. Tao-takh, 23-29/VI/1908 (Volosovich); *Bytanai, right bank of R. Yana, 1885 (Bunge); *between Verkhnekolymsk and Nizhnekolymsk, 30/VI/1889 (Cherskii); *Kolyuchinskaya Bay, 15/VIII/1914 (Starokadomskii); C. Pitlekai, C. Dzhenretlen, Riraitinop on Chukotsk Pen. and C. Nunyamo in Lavrentiya Gulf (cruise of "Vega" in 1878 and 1879).

The species has also been found on the American coast of the Arctic Ocean.

I had the opportunity earlier to make a review of the true bugs of the Arctic (Kirichenko [1916]). Since this work was published, new material has accumulated in the Zoological Institute of the Academy of Sciences USSR. This new material related particularly to the East Siberian part of the Great North Way. There is also some very scrappy data from Chukotsk Pen., Anadyr and the Komandor Is. Publication of all this material is desirable, since it supplements the zoogeographical characterization of the whole zone of Arctic tundra, to which Wrangel I. also belongs.

Only the two following species of true bugs have been found on the Komandor Is. so far;

Irbisia sericans Stål. Bering I., 5/VIII/1931 (Johansen); Mednyi I., 2/VIII/1927 (Rostovykh), 27/XI/1930, 13/1 (indoors), 3/II, 26 and 29/VII, VII-VIII/1931 (Barabash and Klimova).

Callicorixa praeusta Fieb. Bering I., 5/X/1930 (Gur'yanova).

The first of these two species occurs also in Kamchatka, on the northern coast of the Sea of Okhotsk, Valok Bay in Tauiskaya Gulf, 2/VII/1914 (Belousov), on the Pribilov Is., Alaska, Sitka, and in the state of Oregon and belongs to a genus in which all the other species belong to the fauna of Northwest America. C. praeusta Fieb. occurs widely in the palaearctic region, but extends also into North America (Unalasyka, Sitka, Alaska, state of Maine). Its occurrence in the polar zone of Eurasia is noted in the table below; it has been found on the Anadyr, 1/XI/1931 (Portenko) and 17/VI/1938 (Agapov).

On the Anadyr two other species of true bugs have been found:

Aradus lugubris Fall. Novo-Markovo, Anadyr Pen. 16 and 22/VI/1904 (Sokol'nikov).

Salda litoralis L. Anadyr, 1890 (Grinevetskii).

As regards the Chukotsk Pen. I had the opportunity of studying the material collected by N. Gondatti (1896), I. N. Akinfiev (1900), A. Starokadomskii (1913 and 1914) and G. Semenov (1937-1940). In the collections of the Zoological Institute there are specimens with the label "Chukotsk Peninsula, 1896, Gondatti":

Eurydema rugosa Motsch.

Spilostethus equestris L.

Cimex lectularius L.

The first two species were certainly not collected on Chukotsk Pen., but on the way there, since the first is known only from Japan, while the second in Siberia occurs only in its southern latitudes and in Ussuri Territory. I. N. Akinfiev (Vonlyarskii expedition) found Cimex lectularius L. in Glazenap Bay on Chukotsk Pen.

During the voyage of the "Vaigach" and "Taimyr" (Hydrographic Expedition to the Arctic Ocean) L. M. Starokadomskii collected:

Nysius groenlandicus Zett.

Orthotylus discolor J. Sahlb. Karchyk Pen. west of Aion I., 30/VII/1913

Chiloxanthus stellatus Curt. Locality given above.

The greatest number of true bugs from Chukotsk Pen. have become known to us from the collections of G. Semenov, who found there the following species:

Chiloxanthus arcticus Sahlb. Mouth of R. Ichun', Chaunskaya Bay, 28/VI/1939, C. Turyryv, Chaunskaya Bay, 21/VI/1940.

Chiloxanthus stellatus Curt. Mouth of R. Ichun' 1/VII/1939, 8, 15, 20/VI/1940; C. Turyryv, 21/VI/1940.

Calacanthia trybomi J. Sahlb. Mouth of R. Ichun', 1/VII/1939, C. Turyryv, 21/VI/1940.

Nysius groenlandicus Zett. Mouth of R. Ichun', 12/IX/1939.

Orthotylus sp. R. Ichun', VI/1940

Orthotylus artemisiae J. Sahlb. Mouth of R. Ichun', 2/IX/1939; R. Ichun', 28/VII/1940

Chlamydatus wilkinsoni Dgl. Sc. C. Shelagskii, Chaunskaya Bay, 25/VII/1937, 14/VII/1938

A few species are known from the lower reaches of the Kolyma – these are:

Aradus lugubris Fall. Kolyma delta, 1905 (Shul'ga)

Salda litoralis L. Ankudin, opposite Srednekolymsk, 18/VI (Buturlin expedition).

Among its other insect collections the Indigirka expedition of the Academy of Sciences, USSR, collected three species:

Emblethis brachynotus Horv. Valley of R. Moma near its confluence with the Indigirka, 13/V - 1/VI/1929.

Lygus pratensis L. Mouth of R. Moma, 10/VI/1929.

Teratocoris saundersi Dgl. Sc. Valley of R. Indigirka near Abyl village 22/VII/1929.

The routes of the zoological sections of the Yakutia expeditions (1925-1926) of the Academy of Sciences, USSR, were confined within the Olekminsk, Yakutsk and Vilyuisk provinces of the republic, i.e., they did not extend beyond lat. 66° N and thus did not come into the area of our survey. However, B. V. Nikoforov, one of the temporary members of the zoological section was able to establish the presence of the following typical arctic species during a short visit to Verkhoyansk Range:

Aelia frigida Kiritsh. Khotingnakh glacier, right bank of R. Yana near mouth of R. Adycha, 18/VI/1927; on R. Dulgalakh in Tomtor Privince, 21/V; 18, 15/VII/1928.

Emblethis brachynotus Horv. Tomtor, 21/V, 24/VI/1928.

The first information on the true bugs of Taimir Pen. was supplied by the expedition of A. I. Tolmachev and A. G. Makar'in, when one species was found.

Chiloxanthus stellatus Curt., the separate localities of capture are indicated above.

From the lower Yenisei, Igarka, and from the Institute of Polar Agriculture I received the following species for identification.

Aradus lugubris Fall., 21/VI/1938;

Plesiocoris rugicollis Fall., 24/VII/1938;

Saldula c-album Fieb., 19/VI/1938;

Saldula pallipes F., 23/VI/1938.

The lower Yenisei was also included in the work of the Gydan expedition, which obtained:

Chiloxanthus arcticus J. Sahlb., confluence of rivers Yambu-se and Gyda on Gydan Pen., 6/VII/1927. (Naumov).

From old collections from the lower reaches of the Yenisei we must also mention:

Salda litoralis L. Dudinka, 28-31/VII/1907 (Tolstaya); Turukhansk, 13-17/VII/1909 (Shubina).

The greatest number of species have been recorded from the lower Ob. The majority of these were collected by K. P. Samko's expedition on the R. Shchuch'ya in 1928:

Pitedia juniperina L. Labytnangi, north of Obdorsk (below Salekhard), 25/VI/1925 (Fridolin).

Eurydema oleracea L. f. consimilis Horv. Gulf of Ob, Belograv, 29/VI/1921 (Bykov).

Zicrona coerulea L. Little Ob., Kamennyi sands, 30/VI/1928 (Samko).

Aradus lugubris Fall. R. Shchuch'ya, 220 versts from mouth, 16/VII/1928 (Samko).

Trapezonotus arenarius L. Obdorsk, bank of R. Polui, 24/VI/1928 (Samko)

Drymus (Silvadrymus) brunneus Sahlb. Ob, 60 versts below Pogrebnaya junction, 21/VI/1928 (Samko)

Nabis inscriptus Kirby. Berezovo, 21/IX/1928 (Maksimov),

Myrmecophyes alboornatus Stal. Berezovo, 4/VIII/1928 (Maksimov).

Psallus aethiops Zett. Shchuch'ya, 220 versts from mouth, 18/VII /1928 (Samko).

Psallus betuleti Fall. Obdorsk, bank of R. Polui, 24/VI/1928; R. Shaitanka, 25, 26/VII/1928 (Samko); Obdorsk, 28/VII/1930 (Maksimov).

Chlamydatus signatus J. Sahlb. Obdorsk, R, Shaitanka, 23/VII/1928 (Samko).

Limnoporus rufoscutellatus Latr. Berezovo, 12/VI/1928 (Maksimov).

Gerris lateralis Schumm. Obdorsk, 27/VII/1928; Obdorsk, R. Shaitanka, 26/VI/1928 (Samko).

Gerris odontogaster Zett. Berezovo, 12/VI/ and 3/VII/1928 (Maksimov); Obdorsk, 27/VI, 23, 24 29/VII/1928 (Samko); Ob, 30 versts below Obdorsk, 21/VII/1928 (Samko); Shchuch'ya, 220 versts from mouth, 13, 16/VII/1928 (Samko).

Chiloxanthus stallatus Curt. Shchuch'ya, 220 versts from mouth, 13/VI/1928 (Samko).

Salda litoralis L. Obdorsk, R. Shaitanka, 23, 24, 25, 26, 27, 29, 31/VII/1928 (Samko); Ob, 30 versts below Obdorsk, 21/VII/1928 (Samko).

Calacanthia trybomi J. Sahlb. Obdorsk, 20, 31/VII/1914 (Shukhov), 27 and 30/VII/1936 (Plotnikov); Obdorsk, R. Shaitanka, 23, 24, 29/VII/1928 (Samko); Shchuch'ya, 220 versts from mouth, 13, 16/VII/1928 (Samko).

Teloleuca bifasciata Thoms. Ob., 30 versts below Obdorsk, 21/VII/1928 (Samko); Obdorsk, R. Shaitanka, 23, 26, 29/VII/1928 (Samko).

Saldula pallipes F. Obdorsk, R. Shaitanka, 25 26/1928 (Samko); Shchuch'ya, 220 verst from mouth, 13/VII/1928 (Samko).

Callicorixa praeusta Fieb. Obdorsk, 27/VI/1928 (Samko).

On the islands of Novaya Zemlya and Kolguev the following were found:

Calacanthia trybomi J. Sahlb. Foothills of Mt. Chernyshev, lat. 72° 26' 24" N. long. 23° 48' 42" E, 16/VIII/1896 (Yakobson); Matochkin Shar, R. Noguev, 31/VII, 1/VIII/1925 (Vakulenko).

Chiloxanthus borealis Stål. Matochkin Shar, lat. 73° 17' N, 13/VII/1911 (Sumakov); Matochkin Shar, R. Noguev, 1925 (Vakulenko).

Calacanthia trybomi J. Sahlb. was found also in the south of Kolguev, Yurakhiny Solopy, 6-19/VIII/1902 (Buturlin and Mikhailovskii); in the Bol'shezemel'skaya tundra, Kamen'-Yaronei, 27/VII/1908, and without exact locality given, 17-19/VII/1908 (Kertselli; both points in the Pai-Khoi Range between Yugorskii Shar and Mt. B. Savai-Bei), Pustozersk, 3, 24, 25/VI/1905; R. Chirachikha, Pustozersk district, 23/VII/1905, Tel'viske, 17/VII/1906 (Zhuravskii); Varandse I., 9/VIII/1905 (Zhuravskii); in the Malozemel'skaya tundra, Popov's hut, 30/VII/1912 (Oppokov).

A relatively long list of Heteroptera for these latitudes can be drawn up from the collection of G. D. Rikhter and K. E. Vorob'eva in the Bol'shezemel'skaya tundra. In the valley of the R. Shapkina (Pil'vor-Yaga) in 1921 Rikhter discovered a characteristic flood-plain meadow bioceonosis which included Nabis flavomarginatus Scholtz, Lygus viridis Fall., Lygus pratensis L., Stenodema (Brachytropis) trispinosum Reut., Stenodema (s. str.) holsatum F., Teratocoris saundersi Dgl. Sc., Microsynanma bohemanni Fall.

Some information on the hemipteran fauna of the eastern part of the Bol'shezemel'skaya tundra is given by the collections of A. V. Zhuravskii (1904) and N. A. Kulik (1909) in the basin of the R. Adz'va:

Nabis flavomarginatus Scholtz. R. Kharuta, 13/VIII/1909 (Kulik).

Poeciloscytus unifasciatus F. R. Kharuta, 18/VIII, 13/VIII/1909 (Zhuravskii); R. Pym-va-shor, 9/VIII/1909 (Kulik).

Orthotylus borealis Zett. R. Adz'va opposite Niedzal'-vom, 6/VIII/1904 (Zhurarvskii).

Euryopicoris nitidus Mey. D. Village of Niedzel'-vom, 27/VI/1904; near Sadyuku, right tributary of Adz'va, 1/VII /1904; five versts above R. Kharuta, 3/VII/1904; below Shchel'ya-yu, 15/VII/1904 (Zhuravskii); R. Kosseda, 18/VII/1909 (Kulik).

Platypsallus acanthioides J. Sahlb. L. Vashutkiny, 27/VII/1904 (Zhuravskii).

Psallus aethiops Zett. R. Adz'va below Ner'yu-vom, 7/VII/1904; Pyzh-sher, 5/VII/1904 (Zhuravskii).

Chlamydatus wilkinsoni Dgl. Sc. L. Vashutkiny, 27/VII/1904 (Zhuravskii).

Saldula pallipes F. R. Pym-va-yu, 30/VIII/1909 (Kulik)

Calacanthia trybomi J. Sahlb. Mt. Tal'bei, 17/VII/1909 (Kulik).

The insect fauna of the Malozemel'skaya tundra has been studied by L. E. Arens, who found a fairly large number of species of true bugs.

Phimodera lapponica Zett. Yuas-myl'k, sandy mound, 18-19/VI/1934.

Nysius groenlandicus Zett. Sopka village, lower Pechora, 24/IX/1933.

Trapezonotus arenarius L. Yuas-Mul'k, 18 and 19/VI/1934.

Nabis flavomarginatus Scholtz. Tel'viska, lower Pechora, 24/VII/1938.

Lygus pratensis L. Tel'viska.

Capsodes gothicus L. Tel'viska, 24/VII, 6, 7/VIII/1933.

Miris ferrugatus Fall. Tel'viska, 3, 6/VIII/1933.

Trigonotylus psammaecolor Reut. Tel'viska, 6/VIII/1933.

Teratocoris saundersi Dgl. Sc. Tel'viska, 3 and 6/VIII/1933.

Euryopicoris nitidis Mey. D. Tel'viska, 6/VIII/1933.

Criocoris quadrimaculatus Fall. Tel'viska, 6/VIII/1933.

Limnoporus rufoscutellatus Latr. Ust'e village, lower Pechora, 15/VIII/1933.

Gerris lateralis Schumm. Left bank of R. Sedeiyaga, 4/VI/1933.

Saldula saltatoria L. Sopka village, 21/IX/1933.

Saldula c-album Fieb. Tel'viska, 10/VII/1933, right bank.

Saldula pallipes F. Tel'viska, 10/VII/1933.

In 1933 K. E. Vorob'eva had the occasion to observe in the Malozemel'skaya tundra a forest-tundra hemipteran fauna of fairly similar composition.

Nysius groenlandicus Zett. R. Sula, left tributary of Pechora, 20/IX.

Nabis flavomarginatus Scholtz. R. Shapkina, 19/VIII; R. Listvennichnaya, right tributary of Shapkina, 16/VIII.

Anthocoris nemorum L. R. Sula, 26/IX.

Anthocoris limbatus Fieb. R. Sula

Lygus pratensis L. R. Sula, 20/IX (larva)

Poeciloscytus unifasciatus F. R. Listvennichnaya, 16/VIII.

Stenodema holsatum F, R. Sula, 20/IX; Yangyta, right tributary of Sula, 22/IX; R. Listvennichnaya, 16/VIII.

Teratocoris viridis Dgl. R. Listvennichnaya, 16/VIII.

Labops sahlbergi Fall. R. Listvennichnaya, 16/VIII.

Saldula c-album Fieb. R. Sula, 20/IX; R. Yangyta, IX.

To the list of the hemiptera fauna of the Malozemel'skaya tundra we can add two species found by Retovskii in 1955:

Adelphocoris quadripunctatus F. Mouth of R. Pesha, 4/IX/1955.

Salda litoralis L. Mouth of R. Pesha, 4/IX/1955.

This exhausts all the Zoological Institute material on the true bugs of arctic Siberia north of the Arctic Circle, i.e., the material acquired since the publication of my survey of the arctic Heteroptera (Kirichenko [1916]).*

All the information on the occurrence of true bugs in the arctic zone of Siberia is summed up in the table, in which the regions of capture are denoted by Roman figures: I – Wrangel I., II – Komandor Is., III – Chukotsk Pen., IV – Anadyr R., V – lower course of R. Kolyma, VI – lower course of R. Indigirka, VII – lower course of R. Yana, VIII – lower course of R. Lena, IX – R. Olenek, X – lower course of R. Khatanga, XI – Taimyr Pen., XII – lower course of R. Yenisei, XIII – Gydan Pen., XIV – lower course of R. Ob, XV – Kara and Pe-mal'skaya tundras, XVI – Polar Urals, XVII – Novaya Zemlya, XVIII – Kolguev I., XIX – Bol'shezemel'skaya tundra, XX – Malozemel'skaya tundra, XXI – Kanin Pen.

Thus, north of the Arctic Circle in Eurasia, from the Malozemel'skaya tundra to Wrangel I., there have been recorded 73 species of true bugs (Heteroptera), belonging to nine families out of the forty nine families in the world fauna. Two features must be taken into account in the consideration of this factual material. On one hand, the majority of investigators who have worked beyond the Arctic Circle have collected insects, including true bugs, in river valleys particularly of the large Siberian rivers – the Kolyma, Yana, Lena, Yenisei, and Ob. i.e., in the region of ribbonlike penetration of forests far to the north; on the other hand, our material, from the lower Yenisei for instance, came from the wooded tundra region of the Arctic, where larches and other trees still grow, though they are stunted and sparse. The flood-plains of rivers of the tundra zones are covered by rich herbaceous vegetation with a considerable amount of grass; here there occur thickets of bushes, predominantly willows. Only the ocean islands – Wrangel I., Korennoi I. in Khatanga C., Nikandrov in the Yenisei delta, Novaya Zemlya and Kolguev – the peninsulas of Chukotsk, Taimyr, Gydan and Kanin, the Kara and Pe-mal'skaya tundras, and the Polar Urals in our materials give us a true picture of the characteristic hemipteran fauna of the tundra, which differs considerably from the fauna of the rest of the Arctic, as characterized above. No true bugs have yet been found on Spitzbergen or the New Siberian Is.; from Greenland only 5 species are known so far – Nysius

* An exception to this were the collections of Zhuravskii in the Bol'shezemel'skaya tundra and in the Polar Urals. These were identified and merged with the main collection without a record being made and hence it would have required more time to sort them out. For the same reason I did not use the small number of arctic species of Heteroptera, collected by the early expeditions of A. Bunge and E. Toll (1885 and 1886) on the lower Yana, A. Chekanovskii (1875) on the R. Olenek, and I. Cherskii (1891 and 1892) in the basins of the rivers Kolyma, Indigirka and Yana. The hemipteran fauna of the Kola Pen. is a subject of special study by me and together with that of the Little and Northern Urals has been excluded from this work. Some, though not very much hemipteran material (A. Bunge, M. Tkachenko) from Verkhoyansk District is in the Zoological Institute but, since it relates to the forest zone of Eastern Siberia, I considered it more relevant to include it in the work dealing with the hemipteran fauna of Yakutia.

Family and species	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII	XVIII	XIX	XX	XXI
Pentatomidae																					
Phimodera lapponica Zett.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–
Pitedia juniperina L.	–	–	–	–	–	–	–	+	–	–	–	–	–	+	–	–	–	–	–	–	–
Carpocoris (Antheminia) laticollis Jak.	–	–	–	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Eurydema oleracea L.	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–
E. rugosa Motsch.	–	–	?+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Zicrona coerulea L.	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–
Rhacognathus punctatus L.	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–
Aradidae																					
Aradus frigidus Kir.	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–
A. angularis Sahlb.	–	–	–	–	–	–	+	+	–	–	–	–	–	–	–	–	–	–	–	–	–
A. lugubris Fall.	–	–	–	+	+	–	+	+	–	–	–	–	+	–	+	–	+	–	–	–	–
Lygaeidae																					
Spilostethus equestris L.	–	–	?+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Nysius groenlandicus Zett.	–	–	+	–	–	–	–	+	–	–	–	–	–	–	–	–	–	–	+	+	–
N. thymi Wolff	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	+	–
Trapezonotus arenarius L.	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	+	–
Tr. convivus Stål.	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–
Emblethis brachynotus Horv.	–	–	–	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Nabidae																					
Nabis flavomarginatus Scholtz.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	+	–
Cimicidae																					
Cimex lectularius L.	+	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Anthocoridae																					
Anthocoris nemorum L.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–
A. limbatus Fieb.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–
Miridae																					
Allorhinocoris flavus J. Sahlb.	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–
Adelphocoris quadripunctatus F.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–
Calocoris sanojedorum J. Sahlb.	–	–	–	–	–	–	–	–	+	–	–	–	+	–	–	–	–	–	–	–	–
C. fulvomaculatus Deg.	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–
Lygus viridis Fall.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–
L. (Neolygus) contaminatus Fall.	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–
L. pratensis L.	–	–	–	–	–	+	–	–	+	–	–	–	–	–	–	–	–	–	+	+	–
L. (Orthops) mutans Stål.	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–
Plesiocoris rugicollis Fall.	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–
Poeciloscytus unifasciatus F.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–
Irbisia sericans Stål.	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Capsodes gothicus L.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–
Stenodema trispinosum Reut.	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–	–	–	+	–	–
St. holsatum F.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	+	–
Trigonotylus psammaecolor Reut.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–
Teratocoris viridis Dgl. Sc.	–	–	–	–	–	–	–	+	–	–	–	–	+	–	–	–	–	–	+	–	–
T. var. *hyperboreus* J. Sahlb.	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	+	–	–	–	–	–
T. saundersi Dgl. Sc.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–
Leptopterna ferrugata Fall.	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–	–	–	–	+	–
Globiceps sp.	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–
Orthotylus boreellus Zett.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
O. discolor J. Sahlb.	–	–	+	–	–	–	–	–	–	–	–	–	+	–	+	–	–	–	–	–	–
O. artemisiae J. Sahlb.	–	–	+	–	–	–	+	+	–	–	–	–	+	–	+	–	–	–	–	–	–
Labops sahlbergi Fall.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–
L. burmeisteri Stål.	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Euryopicoris nitidus Mey. D.	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	+	–	–	+	+	+
Piezocranum simulans Horv.	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–
Megalocoleus pilosus Schrank.	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–
Platypsallus acanthioides J. Sahlb.	–	–	–	–	–	–	–	+	–	–	–	–	+	–	–	–	–	–	–	+	–
Psallus aethiops Zett.	–	–	–	–	–	–	–	–	–	–	–	–	+	–	+	–	–	–	–	+	–
Ps. betuleti Fall.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	+	–

Family and species	I	II	III	IV	V	VI	VII	VIII	VIIIA	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII	XVIII	XIX	XX	IXXI
Criocoris quadrimaculatus Fall.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–
Plagiognathus arbustorum F. .	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–	–
Pl. obscuriceps Stål	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Pl. albipennis Fall.	–	–	–	–	–	–	–	+	–	–	–	–	+	–	–	–	–	–	–	–	–	–
Chlamydatus pullus Reut. . .	–	–	–	–	–	–	–	+	–	–	–	–	–	–	+	–	–	–	–	–	–	–
Chl. wilkinsoni Dgl. Sc. . . .	–	–	+	–	–	–	–	+	–	–	–	–	+	–	+	–	–	–	–	+	–	–
Chl. signatus J. Sahlb	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–
Microsynamma bohemanni Fall.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–
Gerridae																						
Limnoporus rufoscutellatus Latr.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–
Gerris lateralis Schumm. . . .	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	+	+	–	–	–	+	–
G. odontogaster Zett.	–	–	–	–	–	–	–	–	–	–	–	–	+	–	+	–	–	–	–	–	–	–
Saldidae																						
Chiloxanthus pilosus Fall. . .	–	–	+	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–	–
Ch. arcticus J. Sahlb.	–	–	+	–	–	–	–	–	–	–	–	–	+	+	–	+	–	–	–	–	–	–
Ch. stellatus Curt.	+	–	+	–	+	–	–	–	–	+	+	+	+	–	+	+	+	+	–	+	–	+
Salda litoralis L.	–	–	+	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–	+
Saldula rivularia J. Sahlb. . .	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–	–
S. saltatoria L.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–
S. c-album Fieb.	–	–	–	–	–	–	–	–	–	–	–	–		–	–	–	–	–	–	+	+	–
S. pallipes F.	–	–	–	–	–	–	–	–	–	–	–	–	+	–	+	–	–	–	–	+	+	–
Calacanthia trybomi J. Sahlb.	–	–	+	–	–	–	–	–	–	–	–	–	+	–	+	+	+	+	+	+	+	+
Teloleuca bifasciata Thoms. .	–	–	–	–	–	–	–	–	–	–	–	–	+	+	+	–	–	–	–	–	–	–
Corixidae																						
Sigara carinata C. Sahlb. . .	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	+	–	–	–	–	–	–
Callicorixa praeusta Fieb. . .	–	+	–	+	–	–	–	–	–	–	–	–	–	–	+	+	+	–	–	–	–	–

groenlandicus Zett., Nabis flavomarginatus Scholtz., Chlamydatus pullus Reut., Chl. signatus J. Sahlb., and Capsus sp. (Yakobson [1898]).

A very significant fact is that from Iceland only nine species of true bugs have been recorded so far (Lindroth [1931]): Nysius groenlandicus Zett. (= ericae obscuratus Horv.), Acalypta nigrina Fall., Cimex lectularius L., Microphysa pselaphiformis Curt., Myrmedobia tenella Zett., Teratocoris saundersi Dgl. Sc., Pachytomella parallela Mey. D., Salda litoralis L., and Sigara carinata C. Sahlb.

It is very characteristic that during the Russian Polar Expedition of 1900-1903 (É. V. Toll) such an observant naturalist as A. A. Byalynitskii-Birulya, the biologist of the expedition, did not find any species of this order either in the Taimyr tundra, or on the island of New Siberia or Kotel'noe I. In particular, we should point out that he made a careful study of the fauna of small pools on the New Siberia Is. These pools were heated up to 5-6° by midsummer, and he found in them an abundant population of Phyllopoda, Cladocera, Copepoda and insect larvae (almost exclusively Diptera), but he discovered no Corixae in them: nor did he find them in the coastal lakelets and larger lakes of Taimyr and the New Siberian Is. A no less significant fact is that in an analysis of the stomach contents of birds, of which the minority in the Taimyr Pen. are plant-eaters, A. A. Birulya, did not find any remains of Hempitera (Birulya [1907]). In the following words the entomologist G. G. Yakobson gives an account of his observations on one of the two Novaya Zemlya species of true bugs – Calacanthia trybomi J. Sahlb. – on the south island of Novaya Zemlya near Mt. Chernyshev: "The locality here was covered by fragments of shale and sandstone, among which rose various plants, either in flower or which had flowered and were now bearing fruits". . . "Here green appreciably predominated over other colors". . . "There were two small lakes, deep water filled pits, formed by the steep slopes of the hills. Round the margins of these very sheltered lakes the stones had been fairly well pulverized, and this had produced something resembling a soil layer, broken up in many places by the numerous burrows of lemmings (Cuniculus torquantus Pall. or Myodes obensis Brandt)". . . "My attention was drawn to a vague movement on the surface of the dry grayish lichens which covered the dark stones close to the entrance to the burrows. I involuntarily moved forward, forgetting about the lemmings, and in that instant the movement on the lichens ceased. Peering attentively I noted a grayish insect suddenly running over the surface of the lichen. I immediately caught this insect, which proved to be the bug Acanthia (Calacanthia) trybomi J. Sahlb. Its color was grayish† with small black specks, It could not have harmonized more with the surrounding color of the grayish lichens on the dark gray shales. After some time I caught a second specimen of the bug in the same way, then a third, and so on. These bugs ran fairly rapidly, penetrated among the lichens or even into the lemming burrows, but they were extremely timid; a wave of the hand was sufficient to cause the bug to freeze in the

† After death the ground color of the body of these mites often becomes considerably browner.

pose in which the motion of the hand caught it, and then there was nothing to distinguish it from its surroundings; in spite of all my efforts, I found only 12 specimens in the course of two hours. Neither on the evening of the same day, nor throughout the following day did I succeed in catching a single bug."

It is very typical that N. M. Vakulenko, another investigator of the insect fauna of Novaya Zemlya, who provided the most information about it through his collections, found Calacanthia trybomi J. Sahlb. and Chiloxanthus stellatus Curt. in similar ecological conditions – round the entrances of lemming burrows on the gray lichen-covered slopes of a plateau. Thus, we must infer that in the arctic tundra there is a close association of these two carnivorous species of Saldidae with lemming burrows. This can hardly be related to feeding, since the lemming burrows are not populated, or if they are populated, they contain insignificant numbers of small species of Staphylinidae. It is more probable that these burrows are the natural and only shelter from the strong winds which prevail over most of Novaya Zemlya and which prevent the growth of a herbage cover, and from the dull wet days, which only rarely give way to mild, windless days, when the temperature is 4.4-6.9°.

These descriptions of the conditions of existence of true bugs in the arctic tundras probably give a fairly accurate characterization of the hemipteran fauna of the landscape; As a rule, representatives of the order are absent from the tundra; there are a few species which lurk among the lichens or around lemming burrows, and probably inside them.

I regard it as a firmly established fact that the glacial and tundra fauna of Eurasia is exceptionally poor in representatives of the true bugs. This poverty is revealed both in the number of species and the size of the populations. Typical tundra dwellers are the carnivorous species of the family Saldidae – Chiloxanthus arcticus J. Sahlb., Ch. stellatus Curt., Calacanthia trybomi J. Sahlb and Teloleuca bifasciata Thoms.; a few species of the family Miridae – Orthotylus discolor J. Sahlb., O. artemisiae J. Sahlb., Platypsallus acanthioides J. Sahlb., Chlamydatus wilkinsoni Dgl. Sc. and Chl. signatus J. Sahlb.

Only with the penetration into the tundra of dwarf trees and bushes, primarily willows, which also grow in the tundra of Wrangel I., has the pure tundra hemipteran fauna, with the species composition given above been enlarged by a number of boreal or transpalaearctic species, the northern limit of occurrence of which passes beyond the Arctic Circle. In the diversity of landscape of the arctic zone of Eurasia there is a very pronounced representation of the plant formations of wet lowland bogs – mosses, sedges, cotton-grasses – and of flood-plain meadows along rivers, typified again by the occurrence of thickets of bushes, predominantly willows. The hemipteran fauna of these wooded, meadow and marsh elements of the arctic landscape consist of species widely distributed in the longitudinal direction, or even transpalaearctic species. Thus, the purely woodland forms are Pitedia juniperina L., Rhacognathus punctatus L., all three species of the family Aradidae, Nabis flavomarginatus Schlotz., both species of the family Anthocoridae, Allorhinocoris flavus J. Sahlb., Lygus viridis Fall., Plesiocoris rugicollis Fall., Orthotylus boreellus Zett., Psallus aethiops Zett. Ps. betuleti Fall., and Microsynamma bohemmanni Fall. Mostly they inhabit trees or bushes, mainly willows (Salix) and birches (Betula), and occasionally (Nabis flavomarginatus Scholtz., Allorhinocoris flavus J. Sahlb.) herbaceous plants. Almost all of these are very widely distributed species; their ranges north of the Arctic Circle are only the most advanced salients of their general ranges. Similarly the hemipteran fauna of the flood-plain meadows consists of widely distributed hygrophiles or mesophiles of the family Miridae, including species of Stenodema, Teratocoris, and Labops. Standing and slow-flowing waters of the tundra and forest tundra of this part of the arctic zone are colonized by a heteropteran fauna very poor as regards number of species. This may be explained, on one hand, by the fact that collectors did not employ any special methods of investigating waters though, on the other hand, as we mentioned above, we have the negative results (as regards Heteroptera) of the careful investigation of the fauna of waters of the Taimyr Pen. and the New Siberian Is. by A. A. Birulya. The collections of F. A. Zaitsev, a specialist on aquatic Coleoptera, in the Obdorsk, Kara and Pemal'skaya tundras and in the Polar Urals gave only two species of Gerridae and two of Corixidae, one of which (Callicorixa praeusta Fieb.) was represented by large populations. But on Kola Pen. – on the coast and in the Khibiny – a richer aquatic true bug fauna was collected, and the populations were usually very large.

Zoogeographically the tundra fauna proper, composed of the species picked out above, is characterized by a predominance of endemics and, at the same time, euarcts‡; only Teloleuca bifasciata Thoms. has been recorded from the Altai, Pribaikal'e and Kamchatka as well as from the arctic zone, while Chlamydatus wilkinsoni Dgl. Sc. is known from England and Scandinavia. Only the two species of Orthotylus, which are not found west of the Yenisei, have a restricted range in the longitudinal direction. All the rest have been traced, with breaks, from the arctic zone of Norway and the Kola Pen. to the Chukotsk Pen., and occasionally to the lower Lena (Platypsallus acanthioides J.

‡ Euarcts refers to any euarctic form or species. See "Ecological Animal Geography", by Hesse, Allee, and Schmidt. p. 172—translator.

Sahlb.), Yenisei (Teloleuca bifasciata Thoms) or Ob (Chlamydatus signatus J. Sahlb.). With the sparsity of tundra elements in the arctic hemipteran fauna it is very important to note the arctic endemism and monotypy of two genera – Calacanthia J. Sahlb. and Platypsallus J. Sahlb., which occupy a fairly isolated position in the system of the families Saldidae and Miridae.

In view of the lack of information and material we can only touch very fleetingly on the question of the commonness of the hemipteran fauna of the Arctic and the high Alps, Carpathians, and the Caucasus. The Polar Urals with their quite insignificant altitudes are only a biotope, modern as regards geological history, and giving no evidence of the effect of flaciation. The Alps and the Caucasus have in their hemipteran fauna only one species common to the Arctic – this is Sigara carinata C. Sahlb., which can fairly certainly be regarded as a preglacial relict.

An interesting species is Nysius groenladicus Zett. (N. ericae boscuratus Horv.), which has a typical circumarctic range from Iceland, Greenland, the Kola Pen. and the Malozemel'skaya tundra to the Chukotsk Pen., Alaska and Labrador, and has also been recorded from the high Tien Shan and the Pamir-Alai Range, and from Irkutsk. However, I personally think that we must refrain from introducing it into any zoogeographical theories before the systematics of the whole cosmopolitan genus Nysius has been clarified, and until we have confirmation of the finding of this species (or two species) in the high latitudes of the Arctic (Lat. 73° N in northeast Greenland and at about lat. 70° N on Chukotsk Pen.).

The vast majority of the other species of Heteroptera contained in the list and associated with woodland biotopes (wooded tundra, shrub tundra, sparse woodland) or meadows in river flood plains are palaearctic species widely distributed in the forest zone, or even transpalaearctic species. Only six species are Siberian species – Aradus frigidus Kir., Calocoris samojedorum J. Sahlb., Lygus (Orthops) mutans Stål, Labops burmeisteri Stål., Plagiognathus obscuriceps Stål., and Saldula rivularia J. Sahlb. – and it is important to note that four of them penetrate into the Arctic but, according to the available material, only into the valley of the lower Lena. I described Aradus frigidus Kir. as a subspecies of A. pallescens H.–S. from three specimens from Zhigansk (collection in Helsinki Museum). It is now recognized as an independent species (Tamanini [1955]) and has also been found in Sweden, Italy and Albania. The second species (Calocoris samojedorum J. Sahlb.) belongs to a genus found in all the continents, but it is extremely isolated and is most closely related to two species which inhabit the mountains of Central Asia – C. fedtshenkoi Reut. and C. conspersipes Reut.

We should also note the small group of species of the arctic fauna, the range of which is confined exclusively to the northernmost parts of the forest zone of Eurasia; these include:

Phimodera lapponica Reut. North of Scandinavian Pen., north Finland, Leningrad, Pskov.

Aradus angularis J. Sahlb. Finland, Karelia, Vel'sk, Irkutsk, the Urals, Yakutia.

Trigonotylus psammaecolor Reut. England, Scotland, Scandinavia, North Germany, North Urals.

Orthotylus boreellus Zett. North of Scandinavian Pen., Kamchatka.

Despite the fact that the investigation of the fauna of Wrangel I, and all the faunistic material relating to the whole eastern sector of the Arctic do not provide a basis for general conclusions, a possibility which is even more remote in the case of the true bugs (Heteroptera) because there is an almost total absence of information about the arctic fauna of arctic America, I nevertheless think that the foregoing account gives ground for the following conclusions:

1) A very small number of species of true bugs (Heteroptera) live in the tundra region of the Arctic. The populations of these species are also very small or insignificant, but their ranges include the greater part of Eurasia. Probably most of them have circumpolar ranges.

2) We can state that the arctic zone of Eurasia has been invaded by many eurytopic transpalaearctic species, and to a smaller extent by boreal species of true bugs, biologically associated with trees and bushes (mainly Salix) or with the flood-plain meadow vegetation of the valleys or large rivers and of fresh waters. This invasion has mainly taken place in a longitudinal direction.

3) The bulk of the tundra hemipteran fauna consists of endemic euarcts, including two endemic genera – Calacanthia and Platypsallus, autochthons of Angara origin; its elements are probably all the above-listed Siberian, trans-Yenisei species.

4) The Beringian element of the hemipteran fauna is found in tundra conditions only on the Komandor Is. (Irbisia sericans Stal.)

5) The Arctic hemipteran fauna, fairly homogeneous along the coast line (disregarding America, of which we know very little) has been broken up into several separate zoogeographical areas by invasions from the forest zone. The basic pattern of the distribution of the fauna here is based mainly on the geographical landscape, microrelief and microclimate. If we accept this view, we cannot even attempt to give a general determination of the genesis of the terrestrial animals of the Arctic.

6) As regards the question of the separation of the arctic territories into a separate zoogeographical

unit the true bugs (Heteroptera) once again indicate the need for specificity of approach to different groups of fauna in questions of zoogeography. Thermophilic and xerophilic organisms, such as most of the Heteroptera, cannot, of course, be compared in the arctic conditions with birds, which are aerial immigrants and are mainly closely associated with the sea.

LITERATURE CITED

A. Birulya; "Essays on the life of birds of the polar coast of Siberia," Zap. Akad. Nauk, Fiz.-Mat. otd. 8, 2, 1-XXXVI + 1-157 (1907).

A. N. Kirichenko, "True bugs (Heteroptera). Scientific Results of the Expedition of the Kuznetsov Brothers to the Polar Urals," Zap. Akad. Nauk (VIII), Fiz.-mat. otd. 28, 19, 1-11 (1916).

T. T. Yakobson, "Zoological Investigations on Novaya Zemlya in 1896. Insects of Novaya Zemlya," Zap. Akad. Nauk,, Fiz.-mat. otd. 8, 1, 171-244 (1898).

H. Lindberg, "Hemiptera aus Nordost-Gronland," Skrifter om Svalbord og Ishavet 65, 11-17 (1935).

C. H. Lindroth, "Die Insektenfauna Islands und ihre Probleme," Zoolog. Bidrag fran Uppsala 13, 146-150 (1931).

L. Tamanini, "Caratteri morfologici a cenni biologici sull Aradus frigidus Kiritshenko (Hem., Het., Aradidae)," Mem. Mus. Stor. Nat. Verona 5, 45-49 (1955).

DATA ON THE FAUNA AND ECOLOGY OF LEAF-BEETLES (Coleoptera, Chrysomelidae) OF THE SOUTHERN REAR BANK OF THE DNIEPER RIVER

I. K. Lopatin
Tadzhik State University, Stalinbad
Translated from Éntomologicheskoe Obozrenie, Vol. 39, No. 3, pp. 629-642, July-September, 1960

The creation of reservoirs and irrigation zones in the Lower Dnieper District, along with a change in the climate of this most arid part of the USSR, very markedly affects the composition and distribution of the fauna. As experience shows, the appearance of new biotopes (wooded wind-break strips, cultivated land, parks in unforested places, etc.) leads to a redistribution of faunal elements, a change in their numbers, a replacement of their food plants – in short to a profound change in the biocoenoses.

This study, not pretending to be exhaustively complete, represents an attempt to summarize the knowledge at our disposal of the leaf beetles (Chrysomelidae) of the Southern Rear Bank of the Dnieper. In addition to our own observations and collections for a series of years, the work is based on data placed at our disposal by S. I. Medvedev. I take this opportunity to express to him my sincere gratitude.

A large proportion of the Dnieper Southern Rear Bank District is distributed in the zone of herbaceous-turf, poor-varied-grass steppe (Lavrenko, 1947) on southern chernozem and dark-chestnut soils. From the South this zone is joined by a strip of desert-steppe groups ("wormwood-fescue- feathergrass steppe" after Lavrenko) along the coast of the Black and Azov Seas and the Sivash, distributed on chestnut soils and on basaltic solonchaks. The southwestern part of the district is occupied by a varied-grass-fescue steppe on a sandy terrace of the Dnieper, which is followed immediately by the Dnieper bottomlands. On the borders of this district are found sand bars and islands of the Black Sea coast, the Sivash and the coast of the Azov Sea.

The climate of the Southern Rear Bank of the Dnieper is continental, with an annual amplitude of fluctuation about 28° C. Temperature extremes: -32° C in winter and + 40° C in summer. Annual precipitation at different places in the district varies, but does not exceed 400 mm; in the central part of the district (Askaniya Nova) it attains 360 mm.

In relief the Southern Rear Bank of the Dnieper represents a plain at an elevation of 150 meters above sea level in the upper part to 23 meters in the central part, and 2-4 meters at the bank. A characteristic feature of the relief is the presence of numerous undrained depressions – hollows.

The leaf-beetle fauna of the district is reckoned at 208 species, which should be considered close to capacity. In general, the fauna of the Southern Rear Bank of the Dnieper is poor, which is connected with the uniformity of reliev and the impoverished flora.

The present leaf-beetle fauna is distributed in the following way, according to biotope.

1. Fescue - feathergrass steppe (with a pyrethrum-fescue mixture). The vegetation is represented by feathergrass (Stipa capillata ucrainica and S. lessingiana) and fescue. Of the varied grasses there is sea lavender (Statice sareptana, Goniolimon tataricum), Umbelliferae (Ferula orientalis, Seseli tortuosum, Eryngium campestre), alliaceous plants (Allium sphaerocephalum, A. pulchellum); ephemeroids are represented by the tulip (Tulipa schrenki), and goose onions (Gagea pusilla, G. bulbifera); of the ephemerids thereare: Erophila verna, Veronica verna, Myosotis micrantha, Alyssum desertorum, Cerastium ucrainicum and others.

The following species of leaf-beetles are characteristic for this steppe type: Labidostomis beckeri, Chilotoma erythrostoma, Clytra atraphaxidis, Coptocephala unifasciata, Cryptocephalus apicalis, C. lateralis, Pachybrachis fimbriolatus, Chrysomela marginata, Ch. lurida, Entomoscelis adonidis, Colaphellus hoefti, Phaedon pyritosus, Euluperus xanthopus, Luperus pravei, Galeruca interrupta circumdata, Podagrica malvae, Phyllotreta erysimi, Ph. vittula, Ph. atra, Ph. weiseana, Aphtona nigriscutis, A. abdominalis, A. euphorbiae, Longitarsus fuscoaeneus, Psylliodes cyanoptera.

In the majority of the cases these species are xerophilous and are encountered on flat steppes in large numbers.

2. Steppe depressions (hollows) in fescue-feathergrass steppes are characterized by denser and more varied vegetation with a large number of dicotyledonous plants. Feathergrass invades only the slopes of the hollows, not descending to the bottom; fescue occupies the bottom of the hollows only in drought years. One of the two Askaniya parks is situated on the slopes of a large hollow.

The following species of leaf beetles are characteristic for steppe hollows: Donacia bicolor,

D. Tomentosa, Lema cyanella, L. melanopa, L. pallidipennis, Cryptocephalus gamma, C. janthinus, C. octacosmus, C. connexus, C. fulvus, C. ochroleucus, C. populi, Stylosomus tamaricis, Chrysomela graminis, Ch. cerealis, Entomoscelis adonidis, E. suturalis, Colaphellus sophiae, C. hoefti, Plagiodera versicolorea Phaedon pyritosus, Pb. cochleariae, Luperus xanthopoda, Galerucella luteola, G. nymphaeae, G. calmariensis, Galeruca pomonae, G. circumdata, Crepidodera crassicornis, Chalcoides plutus, Ch. fulvicornis, Epithrix pubescens, Mantura rustica, Haltica palustris, Chaetocnema tarda, Ch. tibialis, Ch. schaeffleri, Ch. conducta, Ch. meridionalis, Ch. mannerheimi, Ch. hortensis, Phyllotreta armoraciae, Ph. ochripes, Ph. nemorum, Ph. procera, Aphthona nigriscutis, A. lutescens, A. czwalinai, A. violacea, Longitarsus pellucidus, L. ochroleucus, L. suturalis, L. lycopi, L. obliteratus, Psylliodes attenuata, P. atriplicis, P. hyoscyami, P. reitteri, Hispella atra, Pilemostoma fastuosa, Cassida viridis, C. Murraea, C. rubiginosa, C. rufovirens, C. parvula.

As is evident from the above list, a proportion of the xerophilous steppe species also enters the hollows, occupying the drier sites on their slopes. Another group, on the contrary, is encountered only in hollows, being meso- and hygrophilous. The list is enlarged on account of a series of species living on herbaceous and arboreal vegetation in one of the Askaniya parks (zoopark), situated on the slopes of the Chapel'sk Hollow. A special, more detailed examination of the park leaf- beetle fauna was made by us (Loparin, 1950).

The richness in the species composition of leaf beetles inhabiting hollows is explained by the increased moisture and a large variety of vegetation.

3. Wormwood-fescue-feathergrass steppes are characterized by the presence, among the plants, of two species of wormwood, Artemisia taurica and A. maritima, and also fescue and kochia Kochia prostrata . Feather-grass Stipa capillata and S. lessingiana are distributed in depressions of the relief. In this zone solonchaks are found with their characteristic floras. The isles of the Sivash have the same character of vegetation. Of the leaf beetles, we encounter here Clytra atraphaxidis, Cryptocephalus gamma, C. flexuosus, C. connexus, C. virens, Stylosomus cylindricus, Pachnephorus canus, Chloropterus versicolor, Chrysomela lurida, Entomoscelis suturalis, Colaphellus hoefti, Phaedon pyritosus, Galeruca circumdata, Podagrica menetriesi, Chaetocnema breviuscula, Ch. nebulosa, Phyllotreta turcmenica, Ph. diademata, Ph. weiseana, Ph. procera, Aphthona aeneomicans, Longitarsus ochroleucus, L. nigrofasciatus, Psylliodes cyanoptera, P. isatidis, P. hyoscyami, Ischyronota desertorum, Cassida nobilis, C. parvula.

Here we encounter a series of eurytopic species of the Gastroidea polygoni, Phyllotreta vittula type, inhabiting most of the biotopes of the Southern Rear Bank of the Dnieper; however, stenotopic species are also found here, adding a specific coloring to the fauna.

Specially characteristic for this section are Cryptocephalus virens, Stylosomus cylindricus, Pachnephorus canus, Chloropterus versicolor, Chaetocnema nebulosa, Phyllotreta turcmenica, Aphthona aeneomicans, Ischyronota desertorum, connected with solonchak vegetation and wormwood.

The species listed almost exhaust the composition of species for the principal biotopes of the two steppe types of the Southern Rear Bank of the Dnieper, which supports the previous statement concerning the poverty of the fauna in this district.

The main mass of the species, however, are distributed outside the steppes, in intrazonal strips: mainly along the Dnieper, partially in artificial arboreal plantations and in smallest quantities on marine sand bars and islands. This is explained by better moisture conditions, to which leaf beetles, being mostly mesophilous insects by nature, are especially sensitive.

4. Sands of the Dnieper meadow terraces, arranged in the form of a terrace stretching from Kamenka to the Dnieper estuary are characterized by the alternation of depressions with close-lying subsurface waters and elevations in the form of wind-blown hillocks. Accordingly, the relief of the sands also arranges the plant groupings. The depressions are occupied by small fresh or salt-lakes, and in the lakes are plant associations, with reeds, sedges, and beach grass in fresh-water depressions and halophytes in salt - water depressions. Along the slopes of the depressions arboreal vegetation is encountered consisting of birch, aspen, oak, blackthorn, buckthorn, willow and alder.

Poorly anchored sands gradually turn into a sandy steppe with feathergrass (Stipa johannis, S. capillata), fescue (Festuca ovina) and Thymus borysthenicus.

The following species are characteristic for the sands of the Dnieper meadow terrace: Donacia bicolora, D. thalassina, D. cinerea, Crioceris 12-punctata, Cr. 14-punctata, Lema tristis, Labidostomis pallidipennis, Tituboea macropus, Cryptocephalus flavicollis, C. bohemius, C. laetus, C. sericeus, C. janthinus, C. moraei, C. populi, Pachybrachis scriptidorsus, P. hieroglyphicus, Pachnephorus villosus, Chrysochus asclepiadeus, Adoxus obscurus, Chrysomela limbata, Ch. cinctipennis, Ch. gypsophilae, Ch. cerealis, Melasoma collaris, M. populi, Phaedon pyritosus, Ph. cochleariae, Galerucella calmariensis, Phyllobrotica elegans, Geleruca tanaceti, G. pomonae, Lythraria salicariae, Chaetocnema conducta, Aphthona nigriscutis, A. abdominalis, A. euphorbiae, Longitarsus jacobaeae, L. pellucidus, Psylliodes cyanoptera, P. isatidis, P. luteola, P. reitteri, Cassida vibex, C. sanguinolenta, C. parvula.

The distribution of leaf beetles among separate biotopes of sands indicates a definite attraction of most species to humid places, such as: margins of fresh-or salt-water marshes, depressions in the sand, arboreal plantations, etc. Here we find most of the leaf beetles presented in the list. The exceptions, living in loose sand, are Chrysomela cinctipennis. Ch. gypsophilae, Ch. cerealis, Longitarsus jacobaea and a series of eurytopic species.

5. The Dnieper drift occupies, in the Southern Rear Bank of the Dnieper, a strip along the left-bank of the shore of the Dnieper, and divides into a series of sections – sandy-shore strip overgrown with marsh vegetation (reeds, rushes, Scirpus lacustris and others), upper shores of alluvial sands covered with Artemisia scoparia, beach grass, Asparagus officinalis, Eryngium planum, meadows of various levels with vegetation consisting of Lythrum, Senecio, Symphytum, Althaea, Cynodon dactylon, Agropyron repens and others. The arboreal vegetation consists mainly of willow, black poplar, buckthorn and alder. On the upper shores of the Dnieper there are numerous lakes and canals, overgrown with eel grass, white and yellow water lilies, salvinia and water chestnut.

The following species of leaf beetles are characteristic for the upper shores: Donacia clavipes, D. crassipes, D. marginata, Crioceris 12-punctata, Cr. 14-punctata, Lema cyanella, Zeugophora scutellaris, Labidostomis cyanicornis, Cryptocephalus laetus, C. janthinus, C. planifrons, Pachybrachis scriptidorus, Pachnephorus villosus, Chrysomela graminis, Plagiodera versicolorea, Melasoma collaris, Phaedon laevigatus, Galerucella nymphaeae, Phyllobrotica 4-maculata, Chalcoides plutus, Epithrix pubescens, Lythraria salicariae, Podagrica menetriesi, Haltica tamaricis, H. impressicollis, Chaetocnema semicoerulea, Ch. mannerheimi, Phyllotreta ochripes, Ph. diademata, Aphthona abdominalis, A. lutescens, A. violacea, Longitarsus rubiginosus, L. suturellus, L. brunneus, Psylliodes luteola, P. hyoscyami, Pilemostoma fastuosa, Cassida viridis, C. murraea.

As evident from the above list, meso- and hygrophilous species are sharply represented on the upper shores. The relative poverty in the species composition of the leaf-beetle fauna on the upper-shore strip is explained by the protracted spring floods, extending to the end of June, during which time a large part of the upper shore is under water.

6. Sand bars and islands of the Azov and Black Sea coasts and Sivash belong to two types according to their origins: separation from the mainland and alluvial accretion connected with former river courses.

The flora and fauna of corresponding origin bear a distinct stamp: islands of mainland origin have an impoverished leaf-beetle fauna, characteristic of the wormwood steppes – Labidostomis beckeri, Cryptocephalus gamma, Stylosomus cylindricus, Chloropterus versicolor, Pachnephorus canus, Chrysomela lurida, Galeruca circumdata, Podagrica menetriesi, Chaetocnema nebulosa, Longitarsus ochroleucus, L. nigrofasciatus, L. lycopi, Psylliodes cyanoptera, Ischyronota desertorum, Cassida parvula. Alluvial sandy islands have a leaf-beetle composition close to that of the Dnieper bottomlands – Crioceris 12-punctata, Coptocephala gebleri, C. unifasciata, Stylosomus tamaricis, Cryptocephalus bohemius, C. sericeus, C. octacosmus, C. planifrons, Pachybrachis hieroglyphicus, Chrysomela cinctipennis, Ch. gypsophilae, Galerucella calmariensis, Crepidodera transversa, Chaetocnema hortensis, Phyllotreta undulata, Ph. diademata, Aphthona lutescens, Longitarsus longipennis, Psylliodes attenuata, P. cyanoptera, P. luteola.

The small number of species is explained by the usual impoverishment of the fauna and the poverty of the floristic composition on islands, and also by the more severe ecological conditions.

The activity of the imaginal stage in leaf beetles is differently manifested in different seasons. In early spring, according to the determination of the relative temperatures, the seasonal aspect of the fauna is represented by species such as Crioceris 14-punctata, Lema melanopa, Chrysomela cinctipennis, Ch. cerealis, Colaphellus sophiae, C. hoefti, Phaedon pyritosus, Chaetocnema breviuscula, Ch. hortensis, Phyllotreta nemorum, Ph. erysimi, Aphthona euphorbiae, Longitarsus obliteratus, L. melanocephalus, Psylliodes cyanoptera and others.

For the period from March 5 to April 20, which we take to be early spring, there appears a total of about 50 species, or 24% of the leaf-beetle fauna. The majority of these species overwinter in the imaginal stage.

We consider May 10 to end the next interval, the middle of spring, when there are species encountered such as Donacia marginata, D. bicolora, Chilotoma erythrostoma, Cryptocephalus flexuosus, Pachnephorus canus, Chrysomela graminis, Melasoma populi, Chaetocnema tibialis, Ch. conducta, Ch. aridula, Aphthona nigriscutis, Longitarsus pellucidus, Cassida nobilis.

Late spring (to May 31) is characterized by the appearance of species such as Donacia clavipes, Lema cyanella, Zeugophora scutellaris, Labidostomis beckeri, Cryptocephalus flavicollis, C. lateralis, series Pachybrachis, Chrysomela violacea, Melasoma saliceti, Euluperus xanthopus, Epithrix pubescens, Podagrica menetriesi, Chaetocnema concinna, Aphthona czwalinai, Longitarsus ochroleucus, Psylliodes dulcamarae, Pilemostoma fastuosa, Cassida berolinensis etc.

Early summer (June 1-30) is the time of greatest variety of species in the leaf-beetle fauna of the district. To the earlier arrivals are added species such as Donacia crassipes, Labidostomis pallidipennis, Clytra valerianae tetrastigma, Coptocephala unifasciata, Crypto-

cephalus populi, C. labiatus, Pachnephorus pilosus, Chrysomela limbata, Entomoscelis suturalis, Luperus xanthopoda, Chalcoides fulvicornis, Haltica tamaricis, H. saliceti, Chaetocnema semicoerulea, Longitarsus jacobaeae, L. tabidus, Psylliodes isatidis, P. luteola, Cassida vibex.

With the end of early summer, there begins a decline in the variety of species in the leaf-beetle fauna of the district, although some species make their first appearance after this period.

In mid-summer (July 1-30) there appear Tituboea macropus, Clytra atraphaxidis, Coptocephala gebleri, Cryptocephalus sericeus, Chloropterus versicolor, Chaetocnema nebulosa, Ch. arida, Phyllotreta turcmenica and Psylliodes reitteri. The general rule is that with each succeeding period the number of species disappearing exceeds the number of those appearing, thus: in late summer (August 1-30) there appear Crioceris 5-punctata, Cryptocephalus laetus, Haltica brevicollis, Phyllotreta erysimi, Longitarsus rubiginosus, Psylliodes atriplicis; in early autumn (September 1-October 10) - Entomoscelis adonidis (second time); and in mid-autumn (October 10-November 20) Phaedon pyritosus (second time), Phyllotreta armoraciae (second time) and Psylliodes chalcomera.

Species present in the fall are generally already leaving to overwinter in the imaginal stage. They are also the first to appear in early spring. This concerns principally a series of species in Chrysomela, Gastroidea polygoni, Phaedon and a series of species in Phyllotreta, Chaetocnema and Longitarsus.

The seasonal dynamics of species composition is closely connected with the appearance of food plants, temperature and precipitation.

Among the leaf-beetle composition present in the Southern Rear Bank of the Dnieper we find a whole series of pests of rural agriculture and silviculture. They may be split into several groups in relation to damage to plants:

1) pests of arboreal species - poplars and willows are damaged by Labidostomis cyanicornis, Pachybrachis hieroglyphicus, Plagiodera versicolorea, Cryptocephalus populi, Melasoma populi, M. saliceti, M. collaris, Zeugophora scutellaris, Haltica tamaricis, Chaetocnema semicoerulea, Chalcoides plutus, Ch. fulvicornis; oaks are damaged by Cryptocephalus labiatus, Haltica saliceti; birch is damaged by Luperus xanthopoda and Galerucella luteola;

2) pests of bread cereals – Lema melanopa, Chaetocnema aridula, Ch. Hortensis, Phyllotreta vittula.

3) pests of cultivated crucifers – Entomoscelis adonidis, Colaphellus hoefti, Phaedon cochleariae, Phyllotreta armoraciae, Ph. undulata, Ph. nemorum, Ph. atra, Ph. weiseana, Ph. nigripes, Psylliodes cyanoptera.

4) pests of industrial crops – Labidostomis beckeri, Chaetocnema concinna, Ch. breviuscula, Ch. tibialis, Aphthona euphorbiae, Longitarsus, pellucidus, Psylliodes attenuata, Cassida nebulosa.

It should be noted that most of the species named, as they are well-defined mesophiles, prefer places with high humidity, for which reason their harmful activity occurs more often along the Dnieper than in fields situated in steppes. However, in the event of a climatic change toward high humidity, all these potential pests could become actual pests without restriction.

In the distribution of the species composition of beetles in the territories of the Southern Rear Bank of the Dnieper, we note a series of interesting peculiarities already noted by S. I. Medvedev (1929) for the entire insect fauna of the Southern Rear Bank of the Dnieper.

Species widely distributed over the entire Palaearctica (and thus termed palaearctic) form a general ground which has not become adapted to a definite biotope. They usually provide no data for zoogeographical conclusions. It should be noted that this group has mixed origins. Very probably a significant number of Angara and Boreal forms penetrated it. Around 25% of the entire leaf-beetle fauna from the Southern Rear Bank of the Dnieper is transpalaearctic. They are species such as Zeugophora scutellaris, Haltica oleracea, Chaetocnema concinna and others.

Boreal species are represented a great deal more weakly (around 6%) on the Southern Rear Bank of the Dnieper. They are distributed mainly along the Dnieper, especially in its terraced parts. To them belong a series of species in Donacia, Chrysomela staphylea, Melasoma collaris, Phaedon laevigatus.

Mediterranean species are represented best of all (around 43%) in the fauna of the Southern Rear Bank of the Dnieper. They are distributed mainly in wormwood-fescue-feathergrass steppes and on marine sand bars, representing the southernmost section of the district. To this group belong species such as Tituboea macropus, Cryptocephalus 5-punctatus, Stylosomus tamaricis, Pachnephorus canus, Phyllobrotica elegans, Crepidodera crassicornis, Chaetocnema schaeffleri and others.

Representatives of the Central Asian fauna are generally poorly represented (around 8%). They are distributed mainly in the fescue-feathergrass steppes and, in fewer numbers, on the sandy terraces of the Dnieper. Here belong Clytra atraphaxidis, Chloropterus versicolor, Chrysomela lurida, Chaetocnema breviuscula, Ch. nebulosa.

Thus, the Mediterranean element in the fauna of the district is represented by the largest number of species, the explanation for which is found in the geographic situation and the history of the faunal structure of the district.

The low percentage of boreal species is explained by the marginal arid climate, for which reason these species are compelled to settle in the most humid biotopes; namely in the Dnieper bottomlands, which is

already an intrazonal area. The ecological conditions for boreal species are not optimal in the predominant biotopes of the district. With a change in microclimate (for example, in artificial arboreal plantations) boreal species may also enter the steppe. The basic nucleus of the fauna apparently was already formed in the Post-Glacial period. The Mediterranean species spread here in the warm and moist Atlantic times, and the Central Asian species in dry and hot xerothermic times.

Of the other peculiarities of the faunal composition, there should be noted the presence of a whole series of eastern species, not crossing over to the west (right) bank of the Dnieper in its downstream part, and by contrast there is an absence of a group of species widely distributed on the right bank. This was noted by A. A. Brauner (1923) and S. I. Medvedev (1929) in relation to mammals and other groups of insects.

Of the leaf beetles not crossing over to the right bank of the Dnieper-downstream, we can name Cryptocephalus lateralis, C. flexuosus, Coptocephala gebleri, Stylosomus cylindricus, Phyllotreta turcmenica schreineri, Apthona lacertosa, A. aeneomicans, Longitarsus fuscoaeneus, Chaetocnema nebulosa, Psylliodes reitteri. These species add a special coloring to the fauna of the Southern Rear Bank of the Dnieper, distinguishing it from neighboring sections of the steppes behind the Dnieper.

The relative poverty of the leaf-beetle fauna of the district is indicated by the absence of a series of genera and a large number of species, characteristic of the surrounding localities, of which the following may be named: Plateumaris Thms., Lilioceris Rtt., Orsodacne Ltr., Gynandrophthalma Lac., Clytra laeviuscula Rtz., Cryptocephalus cordiger L., Ca. aureolus Sff., C. 2-guttatus Sc., Timarcha Latr., Gastroidea viridula Deg., Derocrepis rufipes L., Aphthona beckeri Jacbs., A. gracilis Fald., Longitarsus 4-punctatus Pont., Sphaeroderma St., Psylliodes rhaica Jacbs.

In view of the number of missing forms and the general species composition, the leaf-beetle fauna of the Southern Rear Bank of the Dnieper should be recognized as very poor. Also the species endemism is undeveloped, as a consequence of the geological newness of the territory.

A LIST OF SPECIES DISCOVERED IN THE TERRITORY OF THE SOUTHERN REAR BANK OF THE DNIEPER RIVER

1. Donacia clavipes F. – upper shores of the Dnieper, May 20, on reeds.

2. D. crassipes F. – Dnieper and its branches, June 2-August 17, on leaves of water lilies.

3. D. semicuprea Pz. – sloughs on the shore of the Dnieper estuary, May 22.

4. D. marginata Hop. – Dnieper and its branches June 6-September 30, on sedges.

5. D. bicolor Zsch. – shore of the Dnieper, upper shores, irrigated areas of Askaniya-Nova, May 3-October 25, on sedges.

6. D. thalassina Grm. – Salt Lake Resort on the Kinburnsk Sand Bar, in marshes, June 21.

7. D. vulgaris Zsch. – shore of the Dnieper and channels on the upper shores, June 3-25, on reed mace.

8. D. cinerea Hbst. – Salt Lake Resort, in marshes, June 20, on reed mace and bur reed.

9. D. tomentosa Ahr. – upper shores of the Dnieper, hollows and irrigated areas in Askaniya-Nova, June 3-August 12, on flowering rush.

10. Crioceris 12-punctata L. – upper shores of the Dnieper, interterrace slopes, marshes of the Salt Lake Resort and Dolga and Dzharylgach Islands, May 15-September 15, on asparagus.

11. C. 14-punctata Sc. – as above, April 14-September 28, on asparagus.

12. C. 5-punctata Sc. – upper shores of the Dnieper, rarely, August 9-September 14.

13. Lema cyanella L. – upper shores of the Dnieper and irrigated areas of Askaniya-Nova, May 13-October 21.

14. L. septentrionis Ws. – upper shores of the Dnieper, interterrace slopes, May 16-September 14.

15. L. lichenis Voet. – upper shores of the Dnieper, April 13-May 2.

16. L. tristis Hbst. – Salt Lake Resort in brackish marshes, June 18-Sept. 10, on grasses.

17. L. melanopa L. – upper shore of the Dnieper and irrigated areas in steppes (Askaniya-Nova), not observed in fields, April 11-Sept. 29, on cereals.

18. Zeugophora scutellaris Sff. – upper shores of the Dnieper, May 13-Sept. 30, on black poplar.

19. Labidostomis beckeri Ws. – fescue-feathergrass steppe, hollows, ravines and irrigated areas in steppes, less common on saliniferous steppe slopes along the Sivash and the Churyuk Is., May 14-June 26; polyphagous.

20. L. cyanicornis Grm. – upper shores of the Dnieper and interterrace slopes, May 15-June 21; on black poplar and white willow.

21. L. pallidipennis Gbl. – upper shores of the Dnieper, interterrace slopes, sands of meadow terraces, June 8-August 9, on various willows.

22. Chilotoma erythrostoma Fld. – Fescue-feathergrass steppe and irrigated areas, and also steppe slopes of the Churyuk Islands, May 4-June 18; polyphagous.

23. Titarboea macropus Ill. – Salt Lake Resort, in marshes, July 4-August 8, on couch grass.

24. Clytra valerianae tetrastigma Schm. – Brilevsk Rural Agriculture Station and Interterrace slopes at the Dnieper, June 26-July 12, on field wormwood.

25. C. atraphaxides Pall. – feathergrass-fescue and wormwood steppe, hollows in steppes, July 2-September 4 on Austrian wormwood and kochia.

26. Coptocephala gebleri Gbt. – shell sands of Tendra Is., July 9-11.

27. C. unifasciata Sc. – feathergrass-fescue and wormwood steppe, irrigated areas in steppes, sands of

meadow terraces, sand bars and islands of the Azov and Black Sea coasts, June 4-October 4; polyphagous.

28. Cryptocephalus flavicollis F. – sands of meadow terraces, May 19-June 23, on hedge mustard.

29. C. gamma H. -Sch. – hollows and ravines in feathergrass - fescue steppes, solonchaks of the Yagorlytsk kuta, Perekop, islands and sand bars on the Azov-Black Sea coasts and the Sivash, May 25-October 4, on marine sage.

30. C. bohemius Drp. – sands of meadow terraces and sandy areas on upper shores and on islands of the Black Sea coast, June 4-September 3, on field sage.

31. C. flexuosus Kr. – solonchaks on the coast of the Black Sea and the Sivash, April 29,-July 11, on marine wormwood.

32. C. apicalis Gbl. – feathergrass - fescue steppe and irrigated areas in steppes May 12-July 10; polyphagous.

33. C. lateralis Sff. –virgin areas, feathergrass-fescue steppes; extremely rare in wormwood steppes, May 11-June 26, on thousand-leaf pyrethrum and crooked thistle.

34. C. laetus F. – sands of meadow terraces and upper shores of the Dnieper, August 4-September 29, on composites.

35. C. sericeus L. – meadow-like areas and borderland swamps at the Salt Lake Resort, Burkut and Tendra Isl., July 4-August 9, on elecampane and carrot.

36. C. 5-punctatus Har. – hollows and feathergrass-fescue steppes and the upper shores of the Dnieper, rare, August 9-September 13, on black poplar.

37. C. janthinus Grm. – upper shores of the Dnieper, marshes among sands, swamps at the Dnieper estuary, and also in irrigated areas of Askaniya-Nova, June 17-September 10, on verbena, aspen and warty birch.

38. C. parvulus Müll. – on interterrace slopes, May 13-June 3, on black poplar.

39. C. virens Sff. – wormwood fescue steppe, June 6.

40. C. bipunctatus L. – arboreal plantations at the Salt Lake Resort, May 21-August 4, on oak, birch and dog rose.

41. C. octacosmus Bed. – swampy areas on upper shores, marshes of the Salt Lake Resort and Burkut, irrigated areas of Askaniya-Nova, on Tendra and Dzharylgach islands, May 30-September 6, on couch grass.

42. C. moraei L. – in marshes of the Salt Lake Resort, June 20, on Hypericum perforatum.

43. C. laevicollis Gbl. – in arboreal plantations of the Salt Lake Resort, rarely on upper shores of the Dnieper, May 20-June 19, on buckthorn.

44. C. bilineatus L. – in marshes of the Salt Lake Resort and on Dzharylgach Island, June 18-August 11.

45. C. elegantulus Grv. – marshes of the Salt Lake Resort, June 18-August 4, on grass.

46. C. connexus Ol. – encountered predominantly on saliniferous areas and solonchaks in wormwood-fescue steppes and sands of meadow terraces, July 3-September 24.

47. C. fulvus Gze. – irrigated areas and parks of Askaniya-Nova July 15-16.

48. C. ochroleucus Frm. – rarely in parks of Askaniya-Nova, May 13-15.

49. C. planifrons Ws. – in irrigated areas and parks of Askaniya-Nova, interterrace slopes, on upper shores of the Dnieper and marshes among sands, and also on Tendra and Dzharylgach islands, May 13-August 31, on verbena and spurge.

50. C. populi Sff. – upper shores of the Dnieper, interterrace slopes, arboreal plantations of the Salt Lake Resort and parks of Askaniya-Nova, June 4-August 10, Lombardy poplar, aspen and black poplar.

51. C. rufipes Gze. – on lawns in the parks of Askaniya, May 12.

52. C. labiatus L. – arboreal plantations of the Salt Lake Resort, June 18-August 9, on oaks.

53. Pachybrachis scriptidorsus Mrs. – encountered on upper shores of the Dnieper, on interterrace slopes and sands of meadow terraces, May 24-July 13, on willows.

54. P. hierogylphicus Laich. – encountered with the above, May 5-July 11, on willows.

55. P. tesselatus Ol. – upper shores of the Dnieper, May, on white willow.

56. P. suturalis Ws. – upper shores of the Dnieper.

57. P. fimbriolatus Sff. – in feathergrass - fescue steppes, in steppe hollows and in the parks of Askaniya-Nova, May 4-July 11.

58. P. probus Ws. – in feathergrass - fescue steppes, in steppe hollows and parks and also on upper shores of the Dnieper and marshes among sands, May 19-August 8, on lucern, elecampane, clover, salvia and others.

59. Stylosomus tamaricis H. - Sch. – on Biryuch Island and in the parks of Askaniya-Nova, May 30-July 29, on tamarisk.

60. S. cylindricus Mor. – connected with salinaceous soils, encountered in wormwood-fescue steppes and islands of marine coasts and the Sivash, and also at the Salt Lake Resort, May 25-September 17, on sea lavender.

61. Pachnephorus villosus Dft. – upper shores of the Dnieper and marshes of the Salt Lake Resort, places with rich vegetation, May 20-September 5.

62. P. pilosus Rossi – upper shores of the Dnieper, June 28-September 14.

63. P. Canus Ws.–solonchaks of Churyuk Island, May 3.

64. P. tesselatus Dft. – upper shores of the Dnieper, on grasses and sand, very rarely in wormwood-fescue steppes at the shores of the Sivash, April 13 - Oct. 25.

65. Chrysochus asclepiadeus Pall. – Salt Lake Resort, July 25, 1950.

66. Adoxus obscurus L. – sands of meadow terraces, on grapes.

67. Chloropterus versicolor Mor. – solonchaks of Churyuk Island, Arabat Spit, Yagorlytsk kuta and Salt Lake Resort, July 4-September 17, on Solicornia.

68. Chrysomela limbata F. – sands of meadow terraces, under stones and dry manure, rare, June 20-August 7.

69. Ch. cinctipennis Har. – sands of meadow terraces, in masses on various plants and at the roots, March 14-September 29.

70. Ch. gypsophilae Kust. – mainly on sands of meadow terraces, less commonly on upper shores, singly in feathergrass - fescue and wormwood steppes and in parks of Askaniya-Nova, March 14-September 29.

71. Ch. marginata L. – feathergrass - fescue steppes, sands of meadow terraces, upper shores of the Dnieper, borderland marsches of the Salt Lake Resort and in Burkut, solonchak swamps of Churyuk Island, Dzharylgach Island, April 5-September 21, on composites.

72. Ch. lurida L. – wormwood-fescue steppes, less commonly in feathergrass - fescue steppes and parks of Askaniya-Nova, still rarer on interterrace slopes, March 21-September 13, on salvia.

73. Ch. staphylea L. – upper shores of the Dnieper and marshes of the Salt Lake Resort and Burkut, and also Dzharylgach and Biryuch islands, April 2-August 29, on elecampane.

74. Ch. violacea Müll. – interterrace limestone slopes, May 24, on grass.

75. Ch. graminis L. – upper shores of the Dnieper, swampy places, very rare in parks of Askaniya-Nova, May 3-September 30, on Tanacetum vulgare.

76. Ch. cerealis L. – sands of meadow terraces, rare in upper shores and in Askaniya-Nova, April 12-September 29.

77. Ch. polita L. – upper shores of the Dnieper, marshes of the Salt Lake Resort, hollows of feathergrass-fescue steppes, April 12,-October 25, on pyrethrum.

78. Entomoscelis adonidis Pall. – feathergrass fescue and wormwood fescue steppes, sands of meadow terraces, marshes among sands, Dzharylgach Island, April 30-June 2, again from September 22-October 8.

79. E. suturalis Ws. – Churyuk Island and parks of Askaniya-Nova, May 3-June 16, on Glaucium.

80. Gastroidea polygoni L. – widely distributed over the entire district, most frequently encountered in weedy places, March 21-October 10, on Polygonum.

81. Colaphellus sophiae Sch. – feathergrass fescue steppes and parks of Askaniya-Nova, and also on the Chongarsk Peninsula, rare and single, March 7-June 9.

82. C. heofti Mén. – distributed over the entire district, an abundant species, March 5-June 30, on various crucifers.

83. Plagiodera versicolorea Lch. – upper banks of the Dnieper rarely in parks of Askaniya-Nova, May 3-September 7, on willows.

84. Melasoma collaris L. – sands of meadow terraces, July 9, on willows.

85. M. saliceti Ws. – on interterrace slopes and at the Salt Lake Resort, rare, May 16-July 5, on aspen and black poplar.

86. M. populi L. – upper shores of the Dnieper, interterrace slopes and Salt Lake Resort, less commonly on sands of meadow terraces, May 3-August 11, on willows and poplars.

86 a. Prasocuris phellandrii L. – Golaya Landing, peat bog, July, 1951.

87. Phaedon pyritosus Rss. – feathergrass - fescue and wormwood-fescue steppes, sands of meadow terraces, less commonly on upper shores of the Dnieper, March 21-June 8, again on November 4; polyphagous.

88. Ph. laevigatus Dft. – upper shores of the Dnieper, May 19-September 14.

89. Ph. cochleariae F. – upper shores of the Dnieper, parks of Askaniya-Nova and marshes of the Salt Lake Resort, April 2-October 12, on Sisymbirum sinapistrum.

90. Euluperus xanthopus Dft. – feathergrass-fescue steppes, parks of Askaniya-Nova, interterrace slopes and upper shores of the Dnieper, May 13-June 29, on black poplar, fescue, celery.

91. Luperus xanthopoda Schr. – parks and irrigated places of Askaniya-Nova, April 3-July 4, on elm and blackthorn.

92. L. pravei Jacbs. – feathergrass - fescue steppes and irrigated places of Askaniya-Nova, June.

93. Galerucella luteola Müll. interterrace slopes and parks of Askaniya-Nova, April 12-October 13, on elm.

94. G. nymphaeae L. – upper shores of the Dnieper, rare in parks of Askaniya-Nova, April 13,-September 5, on water lilies and willows.

95. G. calmariensis L. – upper shores of the Dnieper, interterrace slopes, irrigated areas of feathergrass-fescue steppes, Salt Lake Resort and Tendra Island, April 13-October 12, on willows and verbena.

96. G. lineola F. – upper shores of the Dnieper, May 20-September 6, on willows.

97. Phyllobrotica elegans Kr. – upper shores of the Burkut.

98. Ph. 4-maculata L. – upper shores of the Dnieper, swampy places, June 26, 1949.

99. Galeruca tanaceti L. – depressions and marshes among sands at the Salt Lake Resort, June 18-21, on Achillea gerberi.

100. G. pomonae Sc. – upper shores of the Dnieper, sands of meadow terraces, parks of Askaniya-Nova, and also on Dzharylgach Island, June 2-July 6, on wormwood.

101. G. circumdata Dft. – feathergrass - fescue and wormwood-fescue steppes, upper shores of the Dnieper, parks of Askaniya-Nova, June 20-September 28 on wormwood.

102. Crepidodera transversa Mrs. – Burkut, Dzharylgach and Tendra Islands, June 20-August 30, on marshmallow.

103. C. crassicornis Fld. – interterrace slopes and parks of Askaniya-Nova, May 25-October 13.

104. Chalcoides plutus Lch. – upper shores of the Dnieper, Burkut, rarely in parks of Askaniya-Nova, May 12-September 16, on willows.

105. Ch. fulvicornis L. – parks of Askaniya-Nova, June 27, on willows.

106. Epithrix pubescens Koch. – upper shores of the Dnieper, interterrace slopes, Burkut and parks of Askaniya-Nova, May 19-October 21, on nightshade.

107. Ochrosis ventralis Ill. – parks of Askaniya-Nova, rare.

108. Lythraria salicariae Pk. – upper shores of the Dnieper and marshes of the Salt Lake Resort, May 19-October 25, on verbena.

109. Mantura rustica L. – on humid areas of Askaniya parks, May 20, November 11, on Polygonum.

110. Podagrica malvae All. – feathergrass-fescue steppes and parks, April 2-November 26, on Malva pusilla.

111. P. menetriesi Fld. – upper shores of the Dnieper, Salt Lake Resort, Burkut and Churyuk Island, May 16-October 25, on marshmallow.

112. P. fuscipes L. – upper shores of the Dnieper, April 16,

113. Haltica tamaricis Schr. – upper shores of the Dnieper, June 3-September 13, on willows.

114. H. brevicollis Fdr. – marshes in Burkut, August 6.

115. H. oleracea L. – upper shores of the Dnieper, sands of meadow terraces, parks of Askaniya-Nova, April 27-November 11, on Cirsium incanum.

116. H. palustris Ws. – parks and steppe ravines in the region of Askaniya-Nova, Salt Lake Resort, April 20-November 11, on verbena.

117. H. saliceti Ws. – upper shores of the Dnieper, June 25.

118. H. impressicollis Rche. – swampy places on the upper shores of the Dnieper and Salt Lake Resort, May 19-June 24.

119. Chaetocnema tarda Ws. – irrigated areas of Askaniya-Nova, October 13.

120. Ch. semicoerulea Koch. –upper shores of the Dnieper, June 3-September 30, on willows.

121. Ch. concinna Mrsh. – interterrace slopes, sands of meadow terraces, parks of Askaniya-Nova, May 24-October 13, on Polygonum amphibia.

122. Ch. breviuscula Fld. – feathergrass-fescue and wormwood-fescue steppes, fields, upper shores of the Dnieper and parks of Askaniya-Nova, April 2-November 26, on goosefoot.

123. Ch. tibialis Ill. – parks of Askaniya-Nova and steppes on Churyuk island, April 30-September 13, on Chenopodium urbicum.

124. Ch. schaeffleri Ktsch. – ravines and parks of Askaniya-Nova, interterrace slopes, May 14-June 12.

125. Ch. nebulosa Ws. – solonchaks of Churyuk Island, July 20, on glasswort; Yagorlytsk Kut, July, 1951.

126. Ch. conducta Mts. – upper shores of the Dnieper, hollows of feathergrass-fescue steppes, Salt Lake Resort, April 27-October 31, on sedge.

127. Ch. rhombea Ws. – hollows in the region of Askaniya-Nova, May 9.

128. Ch. meridionalis Fdr. – upper shores of the Dnieper, ravines, hollows and parks of Askaniya-Nova, April 27-September 28, on black poplar and rushes.

129. Ch. mannerheimi Gyll – upper shores of the Dnieper, interterrace slopes, parks of Askaniya-Nova, May 12-August 10, on couch grass.

130. Ch. aridula Gyll. – humid herbaceous areas on upper shores of the Dnieper, on sands of meadow terraces, in ravines and parks of Askaniya-Nova, April 28-November 26, on couch grass and sedges.

131. Ch. arida Fdr. – irrigated areas of Askaniya-Nova, July 2, on couch grass and sedges.

132. Ch. hortensis Gffr. – herbaceous areas on upper shores of the Dnieper, on sands of meadow terraces, in parks of Akaniya-Nova, rare on Dzharylgach Island, March 7-November 21, on couch grass and Heliochloa.

133. Ch. compressa Ltz. – interterrace slopes, May 24-June 28.

134. Phyllotreta armoraciae Koch. – parks of Askaniya-Nova, October 12-25, on horse-radish.

135. Ph. ochripes Curt. – upper shores of the Dnieper, Salt Lake Resort, hollows and parks of Askaniya-Nova, April 13-July 31, on Nasturtium austriaca.

136. Ph. undulata Ktsch. – upper shores of the Dnieper, irrigated places and hollows of Askaniya-Nova, Dzharylgach Island, April 2-October 15.

137. Ph. nemorum L. – upper shores of the Dnieper, Salt Lake Resort, Dolgoi Island and wet areas of Askaniya-Nova, April 13-October 31, on Nasturtium.

138. Ph. turcmenica Ws. – solonchaks of Yagorlytsk kuta, July 12.

139. Ph. erysimi Ws. – feathergrass-fescue steppes and parks in steppes, less commonly on interterrace slopes and in wormwood-fescue steppes, April 11-May 27, again on August 5, on Lepidium draba.

140. Ph. vittula Rdt. – herbs, moister places in feathergrass-fescue steppes, on upper shores of the Dnieper, on sands of meadow terraces and on islands and sand bars of marine coasts and the Sivash, March 8-December 5, on couch grass.

141. Ph. cruciferae Gze. – rare everywhere, feathergrass-fescue steppes, parks of Askaniya-Nova, upper shores of the Dnieper, sands of meadow terraces and Tendra Island, April 13-November 11, on Sisymbirum.

142. Ph. atra F. feathergrass-fescue and wormwood fescue steppes, parks of Askaniya-Nova, upper shores of the Dnieper, April 15-November 10, on Sisymbrium.

143. Ph. balcanica, Heik. – feathergrass-fescue steppes, rare, May 7, on couch grass.

144. Ph. diademata Fdr. – upper shores of the Dnieper, Dzharylgach Island and Arabat spit, August 30-September 17.

145. Ph. weisei Jacbs. – an abundant species, feather-grass-fescue steppes, parks of Askaniya-Nova, upper shores of the Dnieper, sands of meadow terraces, less common in wormwood-fescue steppes and on islands and sand bars of marine coasts and the Sivash, March 27-December 5, on Sisymbrium, Lepidium.

146. Ph. curvipes Ogl. – i. 1. – hollows in feather-grass-fescue steppes, May 17.

147. Ph. nigripes F. – moister places in feather-grass-fescue steppes, upper shores of the Dnieper, wormwood-fescue steppe, islands and sand bars of the Black Sea coast and the Sivash, March 21-December 5, on Nasturtium.

148. Ph. procera Rdt. – rare, in feathergrass fescue steppes in moister places (hollows and parks), and also in wormwood-fescue steppes and on Churyuk Island, April 11-October 21, on mignonette.

149. Aphthona nigriscutis Fdr. – feathergrass fescue steppes and irrigated places in steppes, sands of meadow terraces, Tendra Island, May 4-August 8, on spurge.

150. A. abdominalis Dft. – feathergrass-fescue steppes, parks of Askaniya-Nova, sands of meadow terraces, upper shores of the Dnieper, Salt Lake Resort, April 13-November 11, on spurge.

151. A. flaviceps All. – upper shores of the Burkut.

152. A. lutescens Gyll. – upper shores of the Dnieper, outside the upper shores, in the marshes of the Salt Lake Resort, on interterrace slopes, irrigated places and parks in Askaniya-Nova and on marine sand bars of the Black Sea coast.

153. A. czwalinai Ws. – upper shores of the Dnieper and irrigated places in Askaniya-Nova, May 15-July 31.

154. A. nonstriata Gze. – upper shores of the Dnieper, marshes among the sands of meadow terraces, parks of Askaniya-Nova, April 12-November 25, on iris.

155. A. violacea Koch. – upper shores of the Dnieper and parks of Askaniya-Nova, April 16-September 6, on spurge.

156. A. euphorbiae Schr. – feathergrass-fescue steppes and moister places in steppes, upper shores of the Dnieper, sands of meadow terraces, Salt Lake Resort and Dzharylgach Island, March 10-September 15, on spurges and Peganum harmala.

157. A. aeneomicans All. – solonchaks of the Salt Lake Resort, Dolgai Island and Chongarsk Peninsula, May 6-July 13.

158. A. lacertosa Rsnh. – interterrace slopes, June 4.

159. Longitarsus jacobaeae Wat. – connected with sands, of meadow terraces and upper shores of the Dnieper, June 18-September 10, on Senecio.

160. L. pellucidus Fdr. – an abundant species, in feathergrass-fescue steppes more frequently in hollows and parks, on upper shores on the Dnieper, on sands of meadow terraces, in wormwood-fescue steppes, April 26-October 25, on morning glory.

161. L. rubiginosus Fdr. – upper shores of the Dnieper, August 10.

162. L. succineus Fdr. – upper shores of the Dnieper, interterrace slopes, Salt Lake Resort, August 8-September 30, on Srachys.

163. L. substriatus Ktsch. – Askaniya-Nova.

164. L. ochroleucus Mrs. – rare, irrigated in feather-grass-fescue steppes, interterrace slopes of island on the Sivash, May 25-September 28.

165. L. tabidus F. – interterrace slopes, June 23-October 25, on mullein.

166. L. nigrofasciatus Gze. – upper shores of the Dnieper, and Churyuk Island on the Sivash, April 30-October 25, on mullein.

167. L. pratensis Pz. – interterrace slopes, May 24.

168. L. longipennis Ktsch. – Dzharylgach Island, June 20.

169. L. suturellus Dft. – upper shores of the Dnieper and interterrace slopes, April 16-October 25, on willows.

170. L. melanocephalus Dg. – upper shores of the Dnieper, interterrace slopes, parks of Askaniya-Nova, April 12-November 26, on plantain.

171. L. longiseta Ws. – interterrace slopes, May 24-September 14.

172. L. suturalis Mrs. – upper shores of the Dnieper and parks of Askaniya-Nova, June 3-October 25.

173. L. nasturtii F. – upper shores of the Dnieper, May 13-June 3.

174. L. lycopi Fdr. – upper shores of the Dnieper, interterrace slopes, parks of Askaniya-Nova, wormwood fescue steppes, April 14-November 11, on Lycopus europaeus.

175. L. brunneus Dft. – upper shores of the Dnieper and interterrace slopes, May 24, November 5, on Stachys and Symphytum.

176. L. obliteratus Rsnh. – interterrace slopes and upper shores of the Dnieper, parks of Askaniya-Nova and the shore of the Sivash, April 20-November 11, on salvia.

177. L. fuscoaeneus Rdt. feathergrass-fescue steppes and irrigated places in steppes, upper shores of the Dnieper and interterrace slopes, March 7-November 5, on salvia.

178. L. echii Koch. – parks of Askaniya-Nova, April 11, on Echinospermum, Lappula.

179. Dibolia metallica Mts.–interterrace slopes, Burkut, parks of Askaniya-Nova, April 19-September 30, on salvia.

180. Psylliodes attenuata Koch. – upper shores of the Dnieper, interterrace slopes, parks of Askaniya-Nova, Burkut, Dzharylgach Island, April 14-September 15, on Urtica dioica.

181. P. cyanoptera Ill. –feathergrass-fescue steppes parks and irrigated places in steppes, sands of meadow terraces, upper shores of the Dnieper, Dzharylgach and Churyuk islands, April 16-November 4, on Sisymbirum.

In addition to the typical forms the aberrants tricolor Ws. and nigrifrons Heik. are encountered.

182. P. cuprea Koch. – parks of Askaniya-Nova, July 21.

183. P. isatidis Heik. – parks of Akaniya-Nova, Salt Lake Resort, Dzharylgach Island and areas in wormwood-fescue steppes, June 9-August 3.

184. P. atriplicis Jacbs. – irrigated areas in feather-grass-fescue steppes, August 25-September 22, on Chenopodium album.

185. P. luteola Müll. – upper shores of the Dnieper, sands of meadow terraces, Dzharylgach Island, June 23-July 9.

186. P. hyoscyami L. – upper shores of the Dnieper, interterrace slopes, irrigated places in feathergrass-fescue, and also on separate areas of wormwood-fescue steppes, April 9-October 13, on nightshade.

187. P. chalcomera Ill. – parks of Askaniya-Nova, November 15, on Carduus uncinnatus.

188. P. dulcamerae Koch. – interterrace slopes and areas close to upper shores of the Dnieper, May 16-August 10, on Solanum dulcamarae

189. P. reitteri Wse. – in marshes along sands of meadow terraces and in irrigated areas of Askaniya-Nova, July, on reeds.

190. Hispella atra L. – upper shores of the Dnieper, interterrace slopes, Salt Lake Resort, parks of Askaniya-Nova, April 20-September 28, on dry grass.

191. Ischyronota desertorum Gbl. – on solonchaks in wormwood-fescue steppes and islands of the Sivash, July 11-October 9.

192. Pilemostoma fastuosa Schall. – in swampy areas and upper shores of the Dnieper and irrigated places in Askaniya-Nova, May 12-November 4.

193. Hypocassida subferruginea Schr. – feather-grass-fescue steppes, irrigated places in steppes, upper shores of the Dnieper, sands of meadow terraces, May 19-September 30, on Achillea micrantha and others.

194. Cassida viridis L. – upper shores of the Dnieper, parks of Askaniya-Nova, April 14-September 30.

195. C. murraea L. – upper shores of the Dnieper, hollows and irrigated places of Askaniya-Nova, May 13-September 12, on mint and elecampane.

196. C. berolinensis Sff. – upper shores of the Dnieper and parks of Askaniya-Nova, May 22-October 25, on goosefoot.

197. C. nebulosa L. – upper shores of the Dnieper, sands of meadow terraces, parks of Askaniya-Nova, July 5-September 17.

198. C. vibex L. – sands of meadow terraces and vicinity of upper shores of the Dnieper, June 25-July 8.

199. C. rubiginosa Müll. – upper shores of the Dnieper, sands of meadow terraces, irrigated places in Askaniya-Nova, May 12-October 31, on Cirsium incanum.

200. C. sanguinosa Sff. – upper shores of the Dnieper and interterrace slopes, April 14-September 30, on Cirsium incanum.

201. C. rufovirens Sff. – parks and irrigated places of Askaniya-Nova, May 20-November 4, on Matricaria inodora.

202. C. aurora Ws. – parks and irrigated places of Askaniay-Nova, June 9, July 21, on salvia and Achillea.

203. C. sanguinolenta Müll. – Salt Lake Resort, May.

204. C. s. flaviventris Kr. – parks of Askaniya-Nova, Salt Lake Resort, May 26-October 12.

205. C. prasina Ill. – Salt Lake Resort and interterrace slopes, May-June.

206. C. nobilis L. – upper shores of the Dnieper, parks of Askaniya-Nova, Dolga and Orlov Islands. Chongarsk Peninsula, April 27-September 18, on goose-foot.

207. C. parvula Boh. – solonchaks and shores of salty reservoirs, in Askaniya-Nova, in irrigated places, Orlov, Dzharylgach and Churyuk islands, May 20-September 10 on Atriplex lecinatum.

208. C. panzeri Ws. – upper shores of the Burkut, July, 1951.

SUMMARY

1. The Dnieper Southern Rear Bank Steppe belonging to the fescue-feathergrass steppes, together with the wormwood-fescue-feathergrass Black Sea-Sivash Steppe, is the most arid part of the Ukraine steppe zone. The main biotope of the region is the plain steppe; of the intrazonal biotopes the Dnieper bottomlands, sandy fields of the second Dnieper terrace, marine sands and solonchaks are distinguished.

2. Being mainly mesophilous insects, leaf beetles are best represented in the bottomlands of the Dnieper (more than 110 out of 208 species) and in artificially irrigated places (more than 100 species in parks of Askaniya-Nova). Plain steppe has the poorest species composition, which is explained by the extreme drought and the absence of many food plants. Here we recorded a total of 36 species, belonging mostly to genera widely distributed in the Palaearctica.

3. The greatest variety in species is noted in early summer – in June, when the vegetation attains greatest development.

4. The fauna of parks and forest-belts are chiefly species of steppe origin, but in old arboreal plantations their number diminishes on account of immigrants from bottomland forests and hollows. In young forest-belts there are no real forest and mesophilous species.

5. Leaf-beetle species of importance to agriculture at present remain potential pests for a large part of the district, as in their distribution they are attracted to the most humid places along the Dnieper. However, with the irrigation of large territories, their significance is amplified many fold.

6. The zoogeographical analysis of the leaf-beetle fauna of the district studied leads to the conclusion that Mediterranean species (about 43%) predominate in its composition. A somewhat lesser role is played by species widely distributed in a large part of the Palaearctica. Boreal elements are attracted to the Dnieper bottomlands, and species of eastern origin to fescue-feathergrass steppes and solonchaks of marine coasts.

7. Our investigations support the conclusions of other authors of the role of the Dnieper as a zoogeographical boundary and as a conveyor of northern fauna into the steppe zone.

LITERATURE CITED

A. A. Brauner, Rural-Agricultural Zoology, 436 (1923).

E. M. Lavrenko, "Steppes of the USSR," Vegetation of the USSR (1947) Vol. II.

I. K. Lopatin, "Harmful leaf beetles of the steppe and island arboreal plantations of Askaniya-Nova," Tr. Odessk. gos. univ., (1950) Chap. 3, No. 3, pp. 55-58.

S. I. Medvedev, "On the distribution of insects on the Southern Rear Bank of the Dnieper," Izv. Gos. step. zapovedn., (1929) Vol. VII.

S. I. Medvedev, "On the question of insect fauna origins in parks of Askaniya-Nova," Tr. Khark. gos. univ.(1950) 14-15, 67-68.

V. G. Pliginskii, "Data on the Coleoptera fauna of the Tavris circuit," Russk. entom. obozr. (1916) Vol. XVI, 3-4, 346-352.

ON THE FAUNA AND PHENOLOGY OF GAD-FLIES (DIPTERA, TABANIDAE) IN THE NAKHICHEVAN ASSR.

E. G. Hauser

Translated from Entomologicheskoe Obozrenie, Vol. 39, No. 3, pp. 643-660, July-September, 1960

An investigation of the gad-fly fauna of the Nakhichevan ASSR was undertaken in 1939. In that year climatic conditions were unfavorable for the flight of gad-flies. Strong winds blew almost incessantly throughout the summer season and these impeded the flight of insects.

According to local research-workers (e.g., Protchenko and others) and also to the members of a scientific expedition visiting Nakhichevan ASSR (L. I. Prilipko), gad-flies are not infrequently abundant in this territory. In the Ordubad district in that particular year, the author counted 150-200 gad-flies flying around a horse during 3-4 hours observation. This approximates to a mean intensity of not more than 50 gad-flies per hour in flight around a single animal.

In the Batabat district, along the upper boundary of the Bichenakhskii Forest, gad-flies were exceptionally numerous even when the wind velocity was quite high. At the beginning of August, in approximately one hour, it was possible to observe more than 200 gad-flies around a bull.

The Nakhichevan ASSR is bounded on the north east and north west by Armenia and on the south west by Iran The territory of the republic lies on the south western slopes of the Zangezurskii mountains and the south eastern slopes of the Daralagezskii mountain ranges; it descends obliquely to the Middle Araks ravine. The broad valley to the west of the territory narrows in the Dzhul'fa region, and the R. Araks cutting into the Zangezurskii Mountains forms a gorge. Nakhichevan is separated from the rest of Transcaucasia by high mountains and geographically and climatically it is very similar to the neighboring territory of Northern Iran.

Although the Tabanid fauna of Nakhichevan has received very little study, it seems probably that its zoogeographical affinities lie with Iran and Asia Minor generally. Many of the species of gad-fly found in Nakhichevan differ markedly from those of Transcaucasia.

ZONAL DISTRIBUTION OF SPECIES

Four orographical zones are recognized as occurring in Nakhichevan; the Araks lowland zone (600-700 m. above sea level); the foothill zone (up to 1100 m.); the mountain zone (up to 1800 m.) and the high-mountain zone (above 1800 m.).

In general, particular species of gad-fly are associated with one or another of these zones, which are characterized by their hydrographic peculiarities and by their floras. Most of these zones exhibit a high degree of aridity (the mean annual rainfall lies between 200-300 mm) and this limits the area of distribution of Tabanids. As is well-known, gad-flies will only complete their development in places where there is an adequate amount of water. Such localities are to be found in the valleys of the R. Araks and its tributaries, and also in swampy pastures and in the Bichenokhskii Forest, which covers parts of the mountain slopes in the north western area of the Republic.

The river valleys constitute a series of oases in this desert-like territory. They bear the mark of long-standing cultivation with its consequent erosion and represent extrazonal elements in the landscape as a whole. Because of the comparatively gentle slope of the mountains and the gradual descent of the rivers, the vertical changes in the constitution of the flora occur gradually.

Thus, the characteristic elements of the flora at low altitudes may penetrate quite high into the mountains and vice-versa. The same sort of thing may also be observed in the case of the Tabanid fauna of different altitudes. Differences between the distributional ranges of various gad-flies only become apparent when collections are made from stations widely separated in their distance above sea level. Furthermore, it is important to remember that changes take place in the specific composition of the Tabanid fauna in a particular altitudinal zone during the course of the season. There is an apparent "lag" in the temperature regime of habitats at higher elevations compared with those lower down the mountain sides, and certain of the differences between collections and observations made on a given date at points differing in altitude may be attributed to this "lag". For example, the earliest species of Tabanid emerge on about May 10 in the foothill zone; in the early part of June for the mountain zone, but not until the end of July in the high-mountain zone.

This presentation of the Tabanid faunas from

different parts of the Nakhichevan ASSR is based on a study of extensive collections carried out by the author at various points in characteristic altitudinal zones. The collections were made at regular intervals throughout the season at Ordubad but elsewhere they were made more sporadically and some localities were visited by very infrequently.

Collections were made at different stations as follows: 1) Ordubad (about 600 m. above sea level) – more than 20 collections; 2) Danakert (about 1200 m.) 2 collections. 3) Pazmary (about 1700 m.) – 4 collections; 4) Rumys (about 2000 m.) – 3 collections; 5) Batabat – upper limit of timber (1900 m.) – 5 collections. Small collections and certain observations were made during excursions and treks into the Ordubadsk and Megrinsk districts and along the Nakhichevan – Kelany-Bichenax and the Nakhichevan – Arazdayan highways. In addition to material collected during these expedi-

TABLE 1. Zonal Distribution of Tabanid Species Collected.

Numbers	Name of species	Araks lowlands	Foothill zone			Mountain zone		High-mountain zone	
		Arazdayan-Mytry	Nakhichevan-Bichenakh.	Ordubad-Danakert	Megri	Bichenax-Bazabad	Pazmary-Bist	Rumys-Pagraga	Batabad
1	*Chrysops caecutiens ludens* Lw.	–	–	–	+	–	–	–	–
2	*C. flavipes punctifer* var. *abdominalis* Kröb.	+	–	+	–	–	–	–	–
3	*C. sejunctus* Szil.	–	–	–	–	+	–	–	+
4	*Silvius caucasicus molitor* Bog. Sam.	–	+	+	+	+	–	–	–
5	*Tabanus pulchellus* Lw.	++	–	–	–	–	–	–	–
6	*T. fulvus transcaucasicus* Bog. Sam.	–	–	–	–	+	–	+	+
7	*T. proditor* Bog. Sam.	–	–	–	–	+++	–	–	+
8	*T. tricolor pallidicauda* N. Ols	?	–	–	–	–	–	–	–
9	*T. erberi* Br.	++	–	–	–	–	–	–	–
10	*T. bifarius* Lw.	–	–	+	+	–	++	+	–
11	*T. glaucopis* Mg.	–	–	–	–	–	–	+	–
12	*T. lunatus* F.	–	–	–	+	–	–	+	–
13	*T. quattuornotatus* Mg.	+	+	+	+	–	+	–	–
14	*T. turpis* Bog. Sam.	–	–	+	+	–	–	–	–
15	*T. leleani* Aust.	–	+	+	+	–	–	–	–
15a	*T. leleani pallidus* N. Ols.	–	+	+	+	–	–	–	–
16	*T. cordiger* Mg	–	–	++	–	+	–	–	–
17	*T. unifasciatus* Lw.	–	+	++	+	+	++	+	–
17a	*T. unifasciatus pallidus*, subsp. n.	–	–	–	–	–	–	–	–
18	*T. rupium* Br.	–	–	–	–	–	–	–	–
19	*T. regularis* Jaenn.	–	–	++	–	–	–	–	–
20	*T. bromius bromius* L.	+	–	++	++	+++	+++	+++	+++
20a	*T. bromius flavofemoratus* Strobl.	–	++	++	++	–	++	+	–
21	*T. indrae* E. Haus.	–	–	+	+	++	++	+++	+
22	*T. sordes* Bog. Sam.	–	–	++	+	–	++	+	–
23	*T. assuetus*, sp. n.	–	–	+++	+	–	+	–	–
24	*T. infestus* Bog. Sam.	–	–	–	–	+	–	–	–
25	*T. armeniacus* Kröb.	–	–	–	–	+	+	+	–
26	*T. vappa* Bog. Sam.	–	–	–	–	++	++	++	–
27	*T. miki niger* m. *australis*, n.	–	–	–	–	+++	–	–	+
28	*T. spectabilis* Lw.	+	+	+	+	–	–	–	–
29	*T. autumnalis brunnescens* Sz.	–	+	+	+	–	–	–	–
30	*T. atropathenicus* N. Ols.	–	–	+	–	–	–	–	–
31	*T. capito* N. Ols.	–	+	+	++	–	+++	++	–
32	*T. anthrax* N. Ols.	–	–	–	–	–	+	++	–
33	*T. schelkovnikovi* Param.	–	–	+	–	–	+	–	–
34	*T. olsufjevi*, sp. n.	–	–	+	+	–	+	+	–
35	*T. semiargenteus* N. Ols.	–	–	–	–	++	–	–	++
36	*T. swiridowi* Portsch.	–	–	–	–	–	–	–	++
37	*T. apricus* Mg.	–	–	–	–	++	–	+	+
38	*Chrysozona hispanica* Szil.	–	+	+	+	+++	++	+	–
39	*Chr. nubilis*, sp. n.	–	–	–	–	+	–	–	–
40	*Chr. pavlovskii*, sp. n.	+	+	+	–	–	–	–	–
41	*Chr.* sp.	–	–	–	–	+	–	–	–
42	*Chr. pallens* Lw.	+	–	+	–	–	–	–	–
		9	11	25	20	17	15	16	9

Single encounters - one plus sign (+); encountered in quantity - two plus signs (++); encountered in mass quantities - three plus signs (+++).

tions, the author has made extensive use of data from the works of N. Olsuf'ev in this article.

In all, 42 species of gad-flies have been collected by the author or recorded in the literature for Nakhichevan ASSR. The distribution of gad-flies throughout the various zones is given in Table 1.

In the semi-desert ravines, lying between Nakhichevan and Arazdayan, the following species were collected:

1. T. pulchellus Lw.
2. T. erberi Br.
3. T. quattuornotatus Mg.
4. T. bromius bromius L.
5. T. spectabilis Lw.
6. Chr. hispanica Szil.
7. Chr. pavlovskii sp. n.

This rather small number of species obtained from the semi-desert ravines may be attributed to the somewhat cursory collecting which the author carried out in that area. More detailed study would, in all probability, add to the number of species on the list.

Undoubtedly such species as Chrysops flavipes punctifer var. abdominalis Krob and Chrysozona pallens LW., are distributed throughout the Araks valley, as C. flavipes is found at Dzhul'fa and at Ordubad, and C. flavipes and Chr. pallens at Megri.

In the foothill zone of the eastern section of Nakhichevan (Ordubad) 20 species are found:

1. *C. flavipes punctifer* var. *abdominalis* Kröb.
2. *S. caucasicus molitor* Bog. Sam.
3. *T. bifarius* Lw.
4. *T. quattuornotatus* Mg.
5. *T. turpis* Bog. Sam.
6. *T. leleani* Aust.
6a. *T. leleani pallidus* N. Ols.
7. *T. unifasciatus* Lw.
8. *T. cordiger* Mg.
9. *T. rupium* Br.
10. *T. regularis* Jaenn.
11. *T. bromius* L.
11a. *T. bromius flavofemoratus* Strobl.
12. *T. indrae* E. Haus.
13. *T. sordes* Bog. Sam.
14. *T. assuetus*, sp. n.
15. *T. spectabilis* Lw.
16. *T. autumnalis brunnescens* Szil.
17. *T. atropathenicus* N. Ols.
18. *T. capito* N. Ols.
19. *T. schelkovnikovi* Param.
20. *Chr. pavlovskii*, sp. n.

These species are characteristic of the whole foothill zone from Megri in the north east to ıul'fa in the south west. The Tabanid fauna of the villages adjoining Ordubad, i.e., Aza and Keta, which lie in the Araks valley, is identical with that found at Ordubad.

The Tabanid fauna of Dzhul'fa is still practically unknown.

In the Gruzia Museum there is a single specimen of T. (Th.) tricolor pallidicaudata N. ols. with a label "Dzhul'fa on it, but whether this species does actually occur there cannot be confidently asserted. During this month of August, we found T. unifasciatus, T. bromius flavofemoratus, T. spectabilis, T. capito and S. caucasicus molitor in the foothill zone between Nakhichevan and Bichenakh.

Such is the horizontal distribution of species in the foothill zone near to its lower limit. Turning to the vertical distribution of species, we find that the Ordubat fauna changes gradually but in general is distributed as far up as Danakert. At somewhat lower altitudes, e.g. those of Verkhnie Akulisy and Verkhnii Andamich, such characteristic species as T. olsufjevi occur, whilst at Disar (according to the literature) T. anthrax N. Ols. is to be found. T. autumnalis brunnescens Szil and certain other species are absent from the Danakert area. At higher altitudes still, changes in the Tabanid fauna are very noticeable (c.f. below). Above Danakert, near the village of Pazmary, we find a rather different Tabanid fauna. Here the following species occur:

1. *T. bifarius* Lw.
2. *T. quattuornotatus* Mg.
3. *T. unifasciatus* Lw.
4. *T. armeniacus* Kröb.
5. *T. bromius* L.
5a. *T. bromius flavofemoratus* Strobl.
6. *T. indrae* E. Haus.
7. *T. vappa* Bog. Sam.
8. *T. sordes* Bog. Sam.
9. *T. assuetus*, šp. n.
10. *T. schelkovnikovi* Param.
11. *T. anthrax* N. Ols.
12. *T. olsufjevi*, sp. n.
13. *T. capito* N. Ols.
14. *Chr. hispanica* Szil.

This list could undoubtedly be extended by spreading the collecting over a longer period of time so as to include the whole season. Apart from a few exceptions, as compared with the Ordubad fauna, that of Pazmary is characterized by the complete absence of many typical foothill species (e.g. T. regularis); on the other hand it includes such species as T. vappa Bog. Sam, and T. armeniacus, which are absent from Danakert.

In general, the higher one ascends, the poorer the Tabanid fauna in terms of number of species present. At altitudes around 2000 m. near to the village of Rumys, only the following species were found:

1. *T. fulvus transcaucasicus* Bog. Sam.
2. *T. bifarius* Lw.
3. *T. glaucopis* Mg.
4. *T. unifasciatus* Lw.
5. *T. bromius bromius* L.
6. *T. sordes* Bog. Sam.
7. *T. vappa* Bog. Sam.
8. *T. apricus* Mg.
9. *T. anthrax* N. Ols.
10. *T. olsufjevi*, sp. n.
11. *T. capito* N. Ols.

Of these species, T. fulvus transcaucasicus Bog. Sam, and T. glaucopis Mg. Ha. are not found at lower levels. In the alpine pastures above Rumys (Upper Paragachai) only T. anthrax N, Ols. and T. indrae E.

Haus. are found. Lower down the Paragachai river (on the 20th July), T. indrae, T. glaucopis, T. lunatus F., T. fulvus transcaucasicus and T. bromius were captured, whilst lower still, T. olsufjevi sp. n. and T. capito N. Ols. occurred.

To the north west of Paraga, near the village of Bist, in addition to the species which are characteristic of the Rumys area, T. semiargenteus N. Ols. is found. This species flies together with T. olsufjevi, which it closely resembles.

The fauna of Megri, despite the existence of local ecological peculiarities (high humidity, forest vegetation), is very similar to the Tabanid fauna of Ordubad. However, in addition to the species already noted for the latter locality, we found Chrysops caecutiens ludens Lw. and Chrysozona pallens Lw. at Megri.

There are important differences between the Tabanid fauna of the eastern uplands of Nakhichevan and those of the western and central uplands. The climate of the former area is characterized by its somewhat greater humidity, which permits low-growing mountain trees to form woodlands on the mountain slopes and also favors the development of alpine pastures. Collections were made in the eastern uplands at the end of July and therefore the author missed the earlier species, which in all probability can be found in this territory from the beginning until the middle of July.

The following species were noted as occurring in the subalpine pastures at Batabat:

1. *C. sejunctus* Szil.
2. *T. proditor* Bog. Sam.
3. *T. fulvus transcaucasicus* Bog. Sam.
4. *T. miki niger* m. *australis*, n.
5. *T. indrae* E. Haus.
6. *T. bromius* L.
7. *T. apricus* Mg.
8. *T. semiargenteus* M. Ols.
9. *T. swiridowi* Portsch.

At a somewhat lower elevation, on the edge of the forest, the following additional species occurred:

1. *T. unifasciatus* Lw.
2. *T. cordiger* Mg.
3. *T. armeniacus* Kröb.
4. *T. infestus* Bog. Sam.
5. *Chr. hispanica* Szil.
6. *Chr.* sp.
7. *Chr. nubilis*, sp. n.
8. *S. caucasicus molitor* Bog. Sam.

T. swiridowi Portsch, which was found in the subalpine pastures, did not occur at the lower elevation on the forest-edge.

Although the list shows a diverse assemblage (17 forms) of species present in these two habitats, the author does not consider that they represent the total number of species present over the whole season.

From the data given above, it is possible to draw certain conclusions regarding the great diversity of forms inhabiting what is a rather small area of country. There are a surprising number of Tabanid species found in the Nakhichevan ASSR which are apparently endemic to the area comprising Caucasia and the adjacent parts of Iran and Turkey. Such species are:

1. *S. caucasicus molitor* Bog. Sam.
2. *T. unifasciatus pallidus*, subsp. n.
3. *T. turpis* Bog. Sam.
4. *T. indrae* E. Haus.
5. *T. infestus* Bog. Sam.
6. *T. vappa* Bog. Sam.
7. *T. armeniacus* Kröb.
8. *T. miki niger* m. *australis*, n.
9. *T. sordes* Bog. Sam.
10. *T. assuetus*, sp. n.
11. *T. capito* N. Ols.
12. *T. anthrax* N. Ols.
13. *T. atropathenicus* N. Ols.
14. *T. schelkovnikovi* Param.
15. *T. olsufjevi*, sp. n.
16. *T. semiargenteus* N. Ols.
17. *T. swiridowi* Portsch.
18. *Chr. pavlovskii*, sp. n.
19. *Chr. nubilis*, sp. n.
20. *Chr.* sp.

This collection comprises half the total number of gad-fly species in the Nakhichevan fauna. Of these species, some are distributed fairly generally throughout Transcaucasia, but many are confined to certain places or to rather limited regions. The following species are known to occur outside Nakhichevan ASSR:

1) T. turpis. Bog. Sam. and 2) T. sordes Bog. Sam. from Zakatal. These species also occur in the foothills of the Great Caucasian Mts. and may, therefore, be relict types but it is possible that their apparent discontinuous distribution is due to our insufficient knowledge of the Transcaucasian fauna.

3) T. indrae E. Haus. is to be found in small numbers on the northern slopes of the Little Caucasian Mts. and has been recorded from Kusary (northeastern slopes of the Great Caucasian Mts.). It is more common at Nagornii Karabakh than on the north spurs of Murovlaga. It would appear that T. indrae came into Nakhichevan from the north and that in the latter area is its center of distribution. Further to the northwest of Nakhichevan, this species is encountered only in small numbers.

4) T. fulvus transcaucasicus Bog. Sam. also occurs, although rarely, on the northern and northwestern slopes of the Little Caucasian Mts. Elsewhere it is found in Armenia and Northeastern Turkey. The center of distribution for this species must be near to Nakhichevan ASSR.

5) T. assuetus sp. n., in the form of its subspecies cinereus (subsp. n.) is found in the delta of R. Samur. The finding of this sub-species in this locality awaits explanation.

6) T. capito N. Ols. occurs in quantity in the delta of R. Samur. The finding of the two closely allied species T. assuetus and T. capito in the delta of the R. Samur and the proximity of the latter to Kusary, (where T. indrae occurs) suggests some historical links between the fauna of Nakhichevan ASSR on the one hand and the fauna of Southern Dagestan and

Northeastern Azerbaidzhan, on the other. It is possible to suppose that this link once existed by way of Talysh, as it has been found, for example, that certain elements of the Samuran woodland flora occur also in Talysh. Unfortunately, very little is known about the Tabanid fauna of the latter area. T. capito N. Ols. is found on the northern slopes of the mountain range bordering Nakhichevan; these species are known as far up the mountains as Kafana.

7) T. atropathenicus N. Ols. is found at Nagornii Karabakh (frequently) and in the Adzhikenda region, where it is rare (Hauser, 1941:71).

8) T. schelkovnika Param. is known from Northern Iran.

9) T. anthrax N. Ols. and 10) T. swiridowi Portsch. are species known to occur in northeastern Turkey.

11) T. armeniacus Kröb is a very abundant species on the northern slopes of the Great Caucasian Mts. In Nakhichevan this species is rare. It is possible that this is a form endemic to Caucasia.

12) T. miki niger m. australis. Rare in the Little Caucasia Mts., numerous in Nakhichevan. The dark form occurs in the Great Caucasian Mts.

PHENOLOGY AND POPULATION DYNAMICS OF VARIOUS SPECIES

We studied the phenology and population dynamics of gad-flies in most detail at Ordubad. The first of these insects were noticed on May 8th. A deterioration in the weather delayed the mass flight until May 20th. From then on, throughout the season until September, the gad-flies were present, their numbers varying from day to day. No very significant increase in their numbers occurred, however, at any one time, nor was there any prolonged deviation from the norm. The character of the flight, its intensity, and the species involved showed a marked correlation with the weather conditions prevailing at the time – of which we have already spoken. Regarding the predominance of certain species in the Tabanid fauna and also the appearance of rare forms characteristic of the foothills, it is possible to recognize in the development of the flight two distinct periods or two changes in species composition: the spring-summer changes and the late summer change. It is possible that there is also a third, the autumn change, but as our observations terminated at the end of September, this last change is a matter of doubt.

The first "shift" lasts approximately until the 25th of June and is characterized by the presence of the following species: T. bromius flavofemoratus Str., T. cordiger Mg., T. rupium Br., T. quattuornotatus Mg. and possibly T. bifarius Lw. All these species, except the first, are first encountered in small numbers during May and each constitutes a small percentage of the total gad-fly population (maximum 6.1% for T. rupium 2-3 May); the dominant species at this time is undoubtedly T. bromius flavofemoratus Str., which on most days comprises 90% of the individuals captured. At the beginning of July there is a tendency for it to become less abundant.

Of the species which are found at the beginning of summer, some are still on the wing at the end of the season, although their numbers are never large. Such species are: T. unifasciatus Lw., T. autumnalis brunnescens Szil, T. spectabilis Lw. and T. turpis Bog. Sam.

At the end of the first "shift", T. assuetus sp. n. and T. regularis Jaenn. appear; these are forms characteristic of the second "shift". In the case of T. assuetus, solitary individuals were first noticed between June 8th and 10th, but by the 8th of July it constituted 30% of the individuals captured; at the end of August and the beginning of September its relative abundance had increased still further. T. regularis was first recorded on June 25th. In the first half of July it comprised 10-15% of the individuals in the total flight, by the 20th of July its relative abundance had reached 50%, whereas during the first few days of August this figure has risen to 64%. After that T. regularis became relatively less abundant and by September 3rd this species comprised only 19.4% of the total gad-fly population. T. bromius flavofemoratus Str., as we have already stated, became less abundant in early July; by July 20th its relative abundance did not exceed 16-18% of the total gad-fly population, and by the end of August only 8-10%. At the beginning of September, T. bromius flavofemoratus was encountered somewhat more frequently.

Apart from those already mentioned, the following species occurred during the period of the second "shift" which lasted for more than 2 months: T. atropathenicus N. Ols. (25 June, 1 and 13-15 July), T. capito N. Ols. (21 July, 7-9 August), T. schelkovnikovi Param. (20-23 June) and S. caucasicus molitor Bog. Sam. (21 June). T. sordes Bog. Sam. occurred in small numbers from the middle of July until September.

If we relate the above to the zoogeographical nature of the species concerned, we find that the first "shift" contains essentially Central European forms – T. rupium Br. and T. cordiger – whereas these are absent from the second "shift". The second "shift" contains a high proportion of conditional endemic forms. The Mediterranean elements with a wide distributional range are found in both the first and second "shifts" and constitute a background element. Such forms include C. flavipes Mg., T. spectabilis Lw., T. unifasciatus Lw., T. bromius flavofemoratus Str., T. leleani Aust. and T. autumnalis brunnescens Szil. The seasonal rotation of species groups with different zoogeographical affinities is so regular that it must undoubtedly have its origin in this country but at the same time be related to events in the life-cycle of the species in the countries from which they originated; at the present time our knowledge is insufficient to

explain this phenomenon more fully. We were able to show that this regular change in the species composition of the gad-fly fauna at different times of the season was characteristic of the whole foothill zone, although most marked at Ordubad. This conclusion is based on collections and observations made at Dasty, Aza, Ketam and Upper and Lower Akulisy.

Even small changes in the ecological characteristics of the district bring about changes in the specific composition and relative abundance of the gad-fly fauna. Such changes are particularly noticeable when a comparison is made of the vertical (zonal) distribution of various species. On ascending the mountains above Ordubad, it is possible to notice a change taking place in the species of gad-fly attacking animals and in their relative abundance. Thus, at Danakert on July 18th one of the dominant foothill species, T. bromius flavofemoratus Str., comprised only 34.1% of the total collection, whereas at Ordubad on July 8th* the same species comprised 53.4%.

At the time when T. bromius bromius L. was the dominant species at Danakert (34.1%), this same species was only found extremely infrequently at Ordubad (0.7%). T. regularis Jaenn was about as abundant at Danakert as it was at Ordubad, but its comparison species in the latter locality, T. assuetus sp. was rarely encountered at Danakert. T. sordes Bog. Sam. and T. capito N. Ols., particularly the latter, were much more abundant than at Ordubad. Near the village of Pazmary, which was situated at a higher elevation still further changes in the Tabanid fauna were observable.

The most striking changes here were the great decrease in relative abundance of T. bromius flavofemoratus Str., the absence of T. regularis Jaenn., the rarity of T. assuetus sp.n., the increase in abundance of both T. indrae E. Haus and T. sordes Bog. Sam., and finally the appearance of T. vappa Bog. Sam. in quantity.

The village of Rumys is situated high above Pazmary and lies in the high mountain zone. The fauna of Rumys is characterized by the absence of many species which are encountered at lower altitudes and the presence of such forms as T. fulvus transcaucasiscus Bog. Sam., T. glaucopis Mg. and T. apricus Mg.

In the high-mountain, alpine pasture of this part of Nakhichevan ASSR, our observations were interrupted and cut short by the extremely unfavorable meteorological conditions. T. anthrax appeared to be the dominant species here.

In the high-mountain pastures of the northwestern part of the republic (in the vicinity of the survey point of Batabat), T. swiridowi Portsch., T. semiargenteus N. Ols. and T. bromius L. were the most numerous members of the Tabanid species complex at the beginning of August.

Below the alpine pastures at Barabat, near the upper limits of the forest, the species of gad-fly encountered are those set out in Table 2.

TABLE 2. Collections of Gad-Flies Taken Near Barabat Survey Point on the Timberline.

Numbers	Name of species	31 July		3 Aug.		5-6 Aug.		10 Aug.		18 Aug.		Totals	
		no. coll.	%	no. coll.	%	no. coll.	%	no. coll.	%	no. coll.	%	no. coll.	%
1	*Chrysops sejunctus* Szil. . .	2	0.8	—	—	—	—	—	—	—	—	2	0.1
2	*Silvius caucasicus molitor* Bog. Sam.	—	—	1	0.2	—	—	—	—	—	—	1	0.1
3	*Tabanus proditor* Bog. Sam.	5	2	18	4	63	13.2	5	31.2	83	48	174	12.9
4	*T. fulvus transcaucasicus* Bog. Sam	2	0.8	9	2	2	0.6	—	—	—	—	13	0.9
5	*T. unifasciatus* Lw.	4	1.6	3	0.6	2	0.4	—	—	—	—	9	0.6
6	*T. cordiger* Mg.	1	0.4	—	—	3	0.4	—	—	—	—	4	0.2
7	*T. miki niger* m. *australis*, n.	37	15	12	16	57	12.3	1	6.1	—	—	167	12.5
8	*T. indrae* E. Haus.	4	1.6	17	3.6	6	1.2	—	—	—	—	27	1.9
9	*T. armeniacus* Kröb. . . .	—	—	—	—	1	0.2	—	—	—	—	1	0.1
10	*T. infestus* Bog. Sam. . . .	—	—	3	0.6	2	0.4	—	—	—	—	10	0.7
11	*T. vappa* Bog. Sam.	—	—	—	—	1	0.2	—	—	—	—	1	0.1
12	*T. bromius bromius* L. . . .	87	35	230	51.1	269	57	6	44	75	44	667	49.3
13	*T. apricus* Mg.	49	19.7	46	10.7	33	6.9	1	6.2	1	0.5	130	9.6
14	*T. semiargenteus* N. Ols. .	12	4.8	11	2.4	11	2.4	1	6.1	1	0.5	36	2.6
15	*Chrysozona hispanica* Szil. .	45	18.8	40	8.8	22	4.8	—	—	6	3.4	113	8.3
16	*C. nubilis*, sp. n	—	—	—	—	—	—	—	—	2	1.2	2	0.1
	Totals	248	100	450	100	472	100	15	100	172	100	1357	100

In the above table there appears data relating to the flight of only those species of gad-fly which attack animals during the daylight hours. There is in Nakhichevan ASSR one crepuscular species—T. capito N. Ols. The existence of other crepuscular gad-flies has recently been reported from both Western Europe and North America. At the present time we can only surmise that crepuscular species of gad-fly occur in other parts of the USSR; they have not so far been reported. Before our excursion into Nakhichevan

* We compare collections made on different dates because of the climatic "lag" between the upper station and the lower.

ASSR, we had not come across this important biological characteristic of T. capito N. Ols. This species attacks animals in considerable numbers during the evening hours.

The first evening attack by T. capito N. Ols. was observed on the 23rd July near to the village of Pagara in the Ordubad region. It recurred at higher altitudes near the neighboring village of Chananab. In this area, the author was travelling over a desolate, arid plateau, covered with poverty-stricken waist-high vegetation. In the twilight, he noticed two large apparently black gad-flies, which were gyrating around the horses with a loud buzzing sound. From time to time, they attempted to alight on the crupper of the horses. On capturing these Tabanids, they proved to be T. capito.

Evening attacks by T. capito N. Ols. were observed once again on the 11th and 12th of August near the village of Rumys. These evenings were windy; the sky was overcast with dark clouds chasing each other across it. Despite these unfavorable conditions, about 7 or 8 p.m., the gad-flies commenced their flight around the horses. These particular insects continued to fly even after it had begun to rain. The rain, however, soon curtailed their flight.

A massive flight of T. capito. N. Ols. occurred the 14th of August around Pazmary. The horses had been tethered on a grass plot near the river. Throughout the day the weather had been calm and clear and the gad-flies rather abundant. About 4 or 5 o'clock in the afternoon the activities of these insects began to wane. By sunset, only a few individuals of different species were still on the wing; among these T. capito N. Ols: was represented. It is interesting to note that with the approach of evening the numbers of T. capito N. Ols. decreased rather than increased. Only, after sunset, when at about 8 p. m. it was fairly dark, was their flight unexpectedly resumed. At first, they were rather wary and to catch them was difficult. At this time, the attacks of the gad-flies were mainly directed against the horses' spine. After it became quite dark, the insects were less cautious. They attacked the whole of the horses' body; back, flanks, head, belly, limbs – particularly the back. Considering how dark it was, the capture of the gad-flies was not particularly difficult. At 9:30 p.m. the flight, without any warning, slackened. Even at about 10 p.m., there were a few gad-flies around the horses however.

NEW AND LITTLE-KNOWN SPECIES OF GAD-FLY FROM NAKHICHEVAN ASSR

In 1940, on working through our collection of Tabanids from Nakhichevan, we discovered several new species. Bogachev and Samedov (1949) have published descriptions of many of these, but their descriptions are extremely unsatisfactory. This has prompted the author to give, in this paper, a more complete description of certain of these species. A description of T. turpis Bog. Sam. and T. sordes Bog. Sam. is given in another place (Hauser, 1953).

The new species to be described here are: T. assuetus, which Bogachev and Samedov considered to be T. laetetinctus Beck,; T olsufjevi regarded by these authors as an abberation of T. semiargenteus N. Ols., and Chr. nubilis and Chr. pavlovskii. Here also is given a short description of the southern form T. miki niger m. australis, together with T. assuetus subsp. cinereus, which we found in the Samur delta region.

1. Silvius caucasicus molitor Bog. Sam., 1949 (Fig. 1)
Bogachev and Samedov, 1949 : 67.

This subspecies is characterized by the complete absence of black markings on the frontal triangle in the female.

Female. Eyes naked. Frons broad with gray bloom; as wide as the eye. Frontal callosity black, glossy, rather large, partially contained within the frontal triangle. Lateral black stripes at the base of the antennae absent. Antennae black, with gray bloom. Width of first antennal segment only $^2/_5$-$^1/_3$ its length. Face with gray bloom, and short gray hairs. There are small black spots present on the genae. Palps yellowish. Thorax black, with gray bloom. Notum with three, indistinct, gray stripes. Body of thorax with a few gray hairs. Wings transparent, pterostigma brown; r_4 with an appendage. Halteres brown. Limbs gray; tibia yellow, darker at the ends; anterior tibiae with apical third of their length dark-colored; anterior tarsi black, the rest lighter in color, abdomen light-gray. Second abdominal tergite with an indistinct gray triangle in the middle. This figure is absent from the other tergites. On the posterior margin of the sternites is a narrow, pale-colored border 7-8 mm.

Male. as in the type form.

Distribution. Nakhichevan ASSR. Ordubad 21 July 1939, 1 female; near Batabat, lower boundary of forest, August 2, 1 female; Kolany village, August 3, 2 females; Daralagez, Arpa-chai, July 6 1935, 1 female; Gasanriz, Dzhevanshira district, June 23 1912; 1 female; Mergi, June 8, 1939, 2 males.

2. Tabanus (Ochrops) fulvus transcaucasicus Bog. Sam.

(Fig. 2) Bogachev and Samedov, 1949 : 68.

This species is distributed throughout the mountainous region of the Little Caucasian range and the southern slopes of the western extremity of the Great Caucasian range (Abkhaziya). Olsuf'ev, on examining a small number of individuals of this form, regarded it as differing from the type, but not sufficiently to rank as a subspecies. Preserved in the Academy of Sciences. Azerbaidzhan SSR collection are several individuals of this form from Transcaucasia, in which

all the morphological peculiarities are constant and sufficiently well expressed to warrant the form being accorded subspecific rank.

Female. Eyes naked, pale chrome yellow, without stripes. Frontal strip moderately long (its height is $3\,^3/_4$-4 times it width at the base), with parallel sides and covered with yellowish bloom. Frontal callosity completely covered with bloom. Frontal triangle with grayish-yellow bloom, not sharply delimited from the frons itself. Face with yellowish gray bloom and with slender hairs of the same color. Terminal segment of palps pale yellow, markedly thickened at the base, the middle sharply tapered and the end pointed, the whole covered with yellowish hairs mixed with a few black ones. Antennae completely orange-yellow. Third antennal segment very broad, with an almost right-angled dorsal process; rod short, markedly pointed. Thorax with yellow-gray bloom. Notum with short yellow hairs. Halteres yellow. Limbs, for the most part, orange-yellow; femora, gray at the base, distal third of anterior tibiae, anterior tarsi and ultimate segments of the other tarsi black. Wings transparent, veins and basal parts black; the rest of the wings brown, vein r_4 with an appendage. Abdomen covered with golden yellow bloom and short, yellow hairs. Tergites 1-3, together with their corresponding sternites having brownish yellow spots at the side.

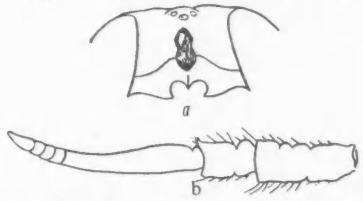


Fig. 1. Silvius caucasicus molitor Bog. Sam. Female a) frons; b) antenna.

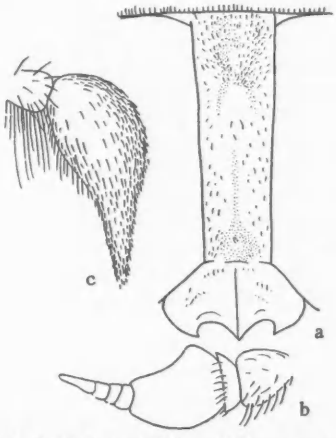


Fig. 2. Tabanus (Ochrops) fulvus transcaucasicus Bog.. Sam. Female. a) frons; b) antennae; c) palp.

Male. There is a single specimen in the Georgian (Gruzian) Museum from Kazikoparana.

This subspecies differs from the type as follows: the eyes are always without stripes; the frontal callosity is covered with powdery bloom; the body is golden yellow. Length 13-15 mm.

Distribution. Found in the Little Caucasian Mts: Mt. Pant (Hauser). Nakhichevan ASSR : Rumys village July 22, 1939, 4 females; August 11-12, 1 female; Batabat, July 31, 2 females; August 3, 9 females, August 5-6, 2 females; Mt. Kirs, July 19 1939, 1 female; Arbabinskii district, near village of Cheldag, July 30, 1935, 1 female (Bartanyan); Kazikoporan, 1 male (Kenig).

3. Tabanus (Ochrops) proditor Bog. Sam., 1949 (Fig. 3)

Bogachev and Samedov, 1949 : 68.

This is an attractive, stocky, pale olive-gray species with light-green eyes and a dense covering of rather long hairs.

Female. Head large, convex. Eyes pale-green, naked, without stripes. Frontal strip moderately narrow, almost parallel sided. Height $3\,^3/_4$-4 times its width at the base; bloom and hairs light olive-gray; the ventral and median frontal callosites completely covered with bloom or the bloom occurs in patches. From the occiput to the eyes, the head is covered with yellowish hairs, some of which project above the upper edge of the eyes. Frontal triangle with olive-gray bloom, feebly delimited from frons. Face with pale olive-gray bloom and pale grayish yellow hairs. Terminal segment of palps grayish-yellow, narrow, blunt at the end and covered with slender whitish, partly black hairs. Antennae yellow. Third segment broad, with a blunt-angled dorsal outgrowth, the tip of which is approximately in the middle of a platform; rod, short and small; thorax with pale olive-gray bloom and hairs of the same color. Notopleura the same shade as the thorax. Halteres yellowish gray. Anterior tarsi black, the rest of the tarsi with dark ends to their joints. Notum with a dense covering of olive-gray bloom and rather long, black and olive hairs. Wings transparent, veins yellowish brown, r_4 with appendage. Basic color of abdomen black with pale brownish spots at the side of first tergite. However, this basic color is completely masked by a dense, olive-gray bloom and olive hairs, which cover the abdomen; Dorsally, there are two longitudinal, narrow, parallel stripes of deeper color than the rest of the tergites.15-17 mm.

Male. Not known.

Distribution. Nakhichevan ASSR : Shakhbuzskii region, upper boundary of forest and subalpine pasture at Batabat; a large number of females. Time of flight from end of July to August 20th.

The species described is similar to T. rusticus

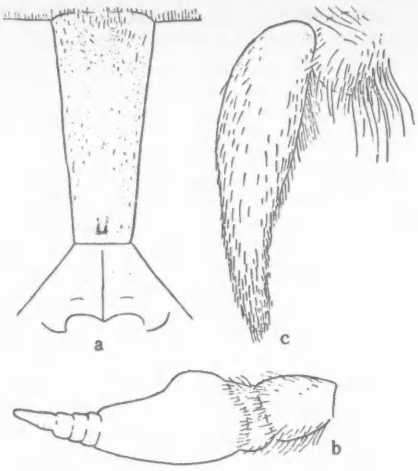


Fig. 3. Tabanus (Ochrops) proditor Bog. Sam. female. a) frons; b) antenna; c) palp.

but can be readily distinguished by its stouter body, massive antenna and by a row of yellow hairs, which project above the occiput.

4. Tabanus (in sp.) assuetus Hauser, sp. n. (Fig. 4)

Female. Eyes naked, without stripes, greenish-brown or gray. Frontal strip narrow, almost parallel-sided; height 5-5 $^1/_2$ times its width at the base. Lower frontal callosity more or less right-angled, glossy black sometimes brownish at the base, with its sides not reaching the eyes, from which they are separated by a strip of bloom. Median frontal callosity more or less spindle-shaped, narrow, with its upper part sometimes bifurcate, joined to the lower callosity by a slender bridge. Frontal triangle rather high, brownish, covered with yellowish-gray bloom. Face with whitish bloom and delicate silver-gray hairs. Antennae light yellow. Third antennal segment relatively narrow, with a blunt dorsal angle. Terminal segment of palp moderately thickened, with a pointed tip, slightly yellowish, covered with short black and white hairs. Notopleura brown or black, with gray bloom. Body of thorax with pale gray bloom and hairs of the same color. Wings transparent, veins brownish, the wing-bases light-colored; vein r_4 without any appendage. Halteres with grayish-yellow stems and whitish-yellow heads; their basal portions are dark. Limbs pale yellow; in some individuals the anterior tarsi and the ends of the tibiae are brownish or black. Pattern on abdomen usually distinct against the gray background of the tergites. It consists of light rhomboidal or triangular patches but is variable. The light patches may extend backwards to the margin of the tergite and fuse with similar patches on the tergite behind, giving 3 longitudinal stripes. The middle stripe consists of the triangular patches. Sometimes the outline of these markings is indistinct and the pattern appears to be smudged. The brownish rose basic coloration of the tergites shows through the bloom. Ventrally the abdomen is rose-gray, the last segment being dark-gray. 11.5-14 mm.

Male. Head large, hemispherical. Eyes distinctly bicolor. The large ommatidial facets are light grayish brown, the small ones – greenish brown. On the boundaries between large and small facets are medium brown stripes. This bicolored appearance of the eye is preserved even in dry specimens. The large facets comprise the upper $^2/_3$ of the head; they are 4-5 times the size of the small facets. Occiput with short hairs. Frontal triangle with yellowish-gray bloom, dorsally it possesses a transverse brown stripe. Antennae pale yellow, narrow. Face pale gray, with delicate white lines. Terminal segment of palp elongate oval, yellowish-white with dense white hairs. Thorax and its appendages, as in female. Abdomen conical, yellow-gray, with 3 rows of light-colored patches, as in female. Underside of abdoemn grayish-rose. Last abdominal segment gray. 12-13 mm. Male and female types are preserved in the collection of the Zoological Institute, Academy of Sciences, Azerbaidzhan SSR at Baku.

Distribution. Ordubad, Kyatam village, Danakert village, Pazmara village, long series of females; Ordubad, June 23, 1939, 1 male; July 17, 1 male; July 26, 1 male.

This species is very similar to T. laetitinctus Beck., but differs from the latter in its lighter-colored antennae, its greater thickening of the last segment of the palp, the grayish tinge of the eye (in life) and the well-marked and distinct pattern on the back and abdomen. It also resembles T. bromius flavofemoratus Str., but differs sharply from this latter species in the absence of stripes in theeyes. T. assuetus is highly variable.

5. Tabanus (in sp.) assuetus cinereus Hauser, subsp. n. (Fig. 5)

The description of this subspecies is based on a single specimen from the Samur river delta. It differs from the typical examples found in Nakhichevan ASSR in the following ways: 1) in the somewhat broader frontal stripe; 2) in the darker antennae, of which the third segment is brown; 3) in the gray color of its limbs, except for the femora which are black with gray bloom and long gray hairs, and the tarsi which are brown; 4) in the characteristic striped pattern on the dorsal surface. The abdominal pattern is black and rather different from that in the typical form. 14 mm.

Male.not known.

Type female is preserved in the collection of the Zoological Institute, Academy of Sciences, Azerbaidzhan SSR at Baku.

Distribution. Near the Samurskii fish factory in the delta of the Samur river, August 25, 1940. 1 female.

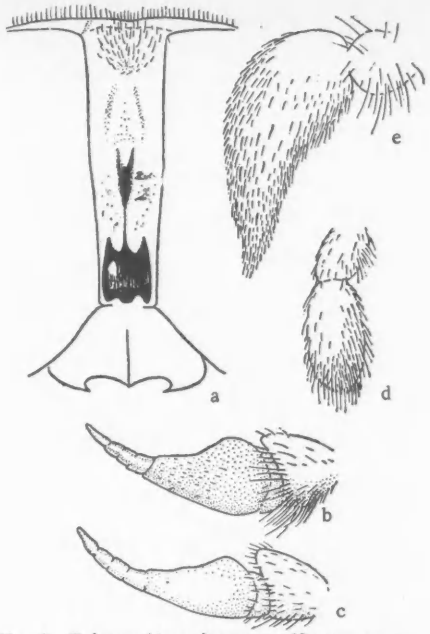


Fig. 4. Tabanus (in sp.) assuetus Hauser, sp.n. a) frons; b) antenna (female); c) antenna (male); d) palp (female); e) palp (male).

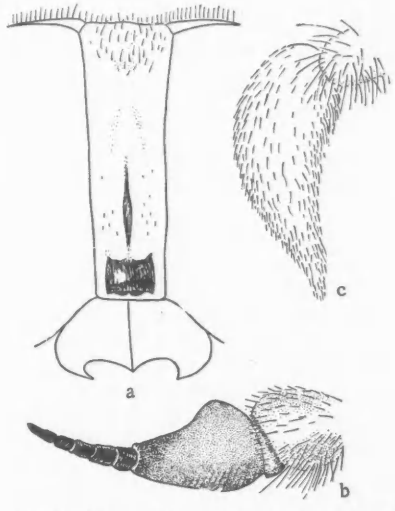


Fig. 5. Tabanus (in sp.) assuetus cinereus Hauser, subsp.n. female. a) frons; b) antenna; c) palp.

6. Tabanus (in sp.) infestus Bog. Sam. (Fig. 6)
Bogachev and Samedov, 1949 : 71.

Female. Eyes naked, brown with a greenish tint, without stripes. Frontal stripe narrow, somewhat tapering at the base, covered with gray bloom and short, light-colored hairs. Occipital stripe – composed of a row of gray hairs projecting above the eyes. Ventral frontal callosity glossy black, more or less rectangular, its lateral walls not reaching the eyes but separated from them by strips of powdery bloom. Median callosity narrow, united at the base with the ventral callosity; its form is that of a narrow spindle which extends upwards to about the middle of the frons. Frontal triangle short, flat, covered with gray bloom. Face pale-gray, with slender silvery gray hairs. Antennae black or blackish brown. Platform of third antennal segment relatively broad, with a triangular, dorsal process; rod slender and pointed at the end, almost as long as the platform.

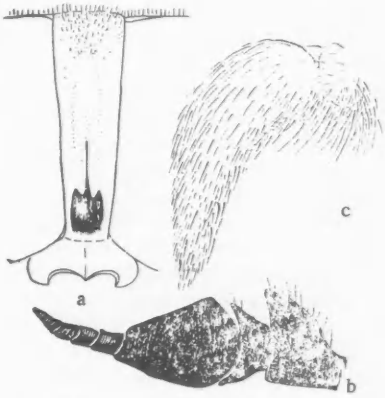


Fig. 6. Tabanus (in sp.) infestus Bog. Sam. Female. a) frons; b) antenna; c) palp.

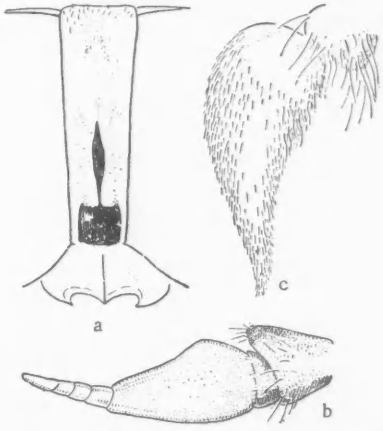


Fig. 7. Tabanus (in sp.) vappa Bog. Sam. Female. a) frons; b) antenna; c) palp.

Terminal segment of palp pale-yellow, narrow, covered with rather long pale hairs mixed with a few black ones. Face with ash-gray bloom and light-gray hairs. Notepleura black, with gray bloom. Thorax black with a delicate ash-gray bloom. Notum with gray bloom and short gray and black hairs; an indistinct longitudinal stripe is present. Halteres brownish black. Wings faintly dappled; veins

black. Limbs: femur, blackish gray; basal portion of anterior tibia and most of the middle tibia, yellow; end of anterior tibia and all the tarsi, black. Abdomen mouse-gray, with an indistinct lighter pattern consisting of three rows of spots, triangular in the middle row, rhomboidal in the lateral rows. Tergites 2-3, sometimes with barely noticeable, lateral, brown spots. Underside of abdomen, gray. 12-15 mm.

Male. Not known.

Distribution. Batabat, near the timber line, July 3, 2 females; August 5-6th 4 females; August 18, 1 female.

The species described is similar to T. bromius L., but may be readily distinguished from the latter by the absence of stripes on the eyes. It also resembles T. indrae E. Haus., but again it differs from this latter species in having antennae which are completely black or blackish-brown, in having long hairs on the palps, in its completely black halteres and in the mouse-gray color of the body.

7. Tabanus (in sp.) vappa Bog. Sam., 1949 (Fig. 7).
Bogachev and Samedov, 1949 : 71.

Female. Eyes naked, dark-green with a brownish tinge, and without stripes. Frontal strip narrow, somewhat expanded dorsally, its height is 4 $\frac{1}{2}$-5 times its breadth at the base; the strip is covered with grayish-yellow bloom and the occipital part is black. Ventral frontal callosity more or less square, black with a brownish base. Median callosity spindle-shaped, black, joined to the ventral callosity by a narrow strip. Antennae orange, 3rd antennal segment rather narrow, with a blunt dorsal outgrowth. Face with pale-gray bloom and hairs of the same color. Terminal segment of palp silvery white, rather narrow, with short pale-colored hairs and a few black ones. Notum dark-gray with longitudinal stripes. Notopleura dark-brown. Body of thorax with gray bloom and hairs of the same color. Limbs: femore, black with gray bloom; tibiae, yellowish-gray; anterior tibiae, dark at the extremities; tarsi, dark-brown; halteres, gray-brown, dirty white on their knobs. Wings slightly dappled, veins brown, with their basal portions lighter in color; r_4 without appendage. Abdomen grayish-black; at the sides of tergites 1-4 there are light-colored rhomboidal patches, which in life are rose-pink. A longitudinal stripe runs down the middle of the abdomen, taking up about half its breadth; in this dark-colored stripe are found small, lighter-colored, triangular patches. The abdomen is grayish-pink ventrally; the last stermite is gray. 14-17 mm.

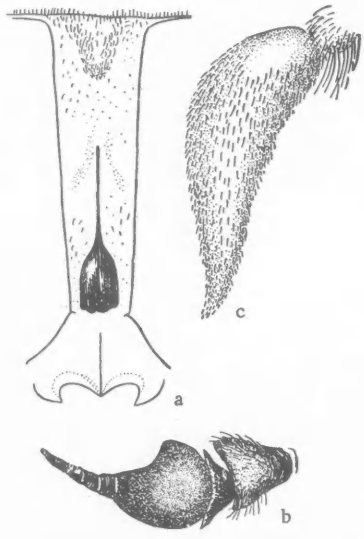


Fig. 8. Tabanus (in sp.) olsufjevi Hauser sp.n. female. a) frons; b) antenna; c) palp.

Distribution. Pazmary village, Ordubad region, several females.

T. vappa Bog. Sam. resembles T. indrae E. Haus., but differs from the latter species in its light-colored antennae, the brownish color of the ventral callosity and the different abdominal pattern.

Male. Not known.

8. Tabanus (in sp.) miki niger m. australis Hauser,n.

Female. Resembles typical form of species, but is given subspecific status because it has brown spots on the sides of tergites 2-3. Sometimes these light-colored spots spread to tergites 4-5. In addition to the pale form, completely black individuals occur, which closely approximate to T. miki niger N. Ols. The base of the third antennal segment is generally dark-brown.

Male. Not known.

Type female is found in the Zoological Institute collection, Academy of Sciences, Azerbaidzhan SSR.

Distribution. Mountains of Pant Khanlarskii region (rare), Nakhichevansk ASSR. Shakhbuzskii region, timber line near Batabat (in quantity).

9. Tabanus (in sp.) semiargenteus N. Ols. (in part)

Under the name T. semiargenteus Olsuf'iev described a species, which actually consisted of two very closely related forms. On the basis of our own wealth of material, we have been able to separate these forms as distinct species. The females of the typical form closely approximate to the description given by Olsuf'iev, but because of certain inaccuracies in the latter, the author proposes to describe this species anew.

Female. Eyes naked, without stripes. Frontal strip narrow, its height is 5-5 $\frac{1}{2}$ times its width at the base, covered with gray bloom. Ventral frontal callosity black, elongate-oval, with its lower margin rounded or with two barely noticeable convexities. Median callosity in the form of a narrow, keel-like,

black strip joined to the tip of the ventral callosity. Frontal triangle and face with light-gray bloom, face with light-silvery hairs. Antennae completely black; third antennal segment rather narrow with its upper corners right-angled. Terminal segment of palp yellowish-black, elongated, flat, blunt-ended and covered with short black and slender grayish hairs. Notum blackish-gray, with poorly discernible stripes and black hairs. Notopleura black, with grayish bloom and black hairs. Walls of thorax with whitish hairs. Wings transparent; field of costal cell slightly darkened. Veins dark brown, costal veins black; first postero-marginal cell with a strongly tapered tip; limbs mostly black, only the basal third of the tibiae grayish yellow. Halteres brownish, their ends dirty yellow. Abdomen gives the impression of being covered with mold, for the first and third tergites and sides of the fourth tergite are covered with a delicate whitish-bloom and dense, silvery white, short hairs. The basic brownish-yellow color of the abdomen shows through the bloom, giving the latter a rosy tinge. Tergites 5-7, black with black hairs. In the middle of tergites 2-4 there are black patches, in which occur triangular markings of a paler color. Only on the last tergite is the triangular marking really distinct. Ventral surface of abdomen rosy gray with a rather wide, median, dark stripe. Tergites 6-7, black. 21-24 mm.

The fundamental differences between T. semiargenteus N. Ols. and T. olsufjevi, sp.n. are as below:

T. semiargenteus N. Ols.		T. olsufjevi sp.n.
1) Mean length	20-22 mm	23-25 mm.
2) Color of abdomen	rosy	yellowish
3) Rings on abdominal segments 5-7	black	gray
4) Platform on 3rd antennal segment	narrow	broad
5) Costal vein	black	light brown

Male. Not known.

Distribution. Shakhbuzskii region, Batabat, several females; Bilav, Ordubad region, females.

Type female in Zoological Institute collection, Academy of Sciences, USSR, Leningrad.

10. Tabanus (in sp.) olsufjevi Hauser, sp. n. (Fig. 8)

This large and attractive species was included by Olsuf'ev under T. semiargenteus, which species it closely resembles. Bogachev and Samedov described it (1949) as an abberation of T. semiargenteus.

Female. Eyes naked, without stripes, Frons narrow, its height is 4 3/4-5 times its basal width; covered with yellowish bloom, and in the occipital region with short black hairs. Ventral frontal callosity black, elongate-oval, tapered dorsally and with the lower margin rounded, or with 2 barely noticeable convexities. Median callosity narrow, keel-like, joined to the tip of the ventral callosity. Frontal triangle with plae yellowish-gray bloom. Face with light-gray bloom and whitish hairs. Antennae: first and second segments brown, platform of third segment dark-brown, rod black, broad, with a blunt dorsal angle. Terminal segment of palp gray, moderately narrow, flat, with a pointed end, equally covered with short black and yellow-gray hairs. Notum dark gray with barely noticeable longitudinal stripes. Notopleura brown with black hairs. Walls of thorax with whitish hairs. Wings colorless, only the costal fields slightly darkened. Veins dark, almost black, brownish at the base of the wings; costal veins brown, r_4 with appendage; first postero-marginal cell strongly tapered at the apex. Limbs mostly black, with gray bloom, only the basal portions of the tibiae yellowish-brown. Middle and hinder tibiae, lighter than the rest of the limbs. Halteres brownish, dirty yellow at the end. Abdomen of a characteristic yellow color. Tergites 1-4 and often tergite 5 covered with pale yellow hairs. There is a barely distinguishable gray stripe down the middle of the abdomen, on which are situated indefinite triangular patches; the last tergite is gray. Ventrally the abdomen is a pale grayish-rose color with an indistinct median stripe. Last sternite dark gray. 22-25 mm.

Male. Head large, convex; eyes naked without stripes. Upper facets of eyes considerably larger than lower facets. Boundary between large-facet field and small-facet field not very sharp. Occiput with light colored hairs which project above eyes. Antennae dark brown, rods black, narrow. Face with gray bloom and hairs of same color; notopleura dark brown with black hairs. Notum black, with dark gray bloom and black and rust-colored hairs; its stripes are faint. Limbs almost completely black, only the base of the middle and hind tibiae yellow, base of front tibiae brown, with grey hairs. Abdomen pointed, colored as in female.

Distribution. Ordubad region, several females; 1 male from Nus-Nus village, August 1, 1935 (M.P.)

11. Chrysozona pavloskii Hauser, sp.n. (Fig. 9)

Female. Eyes with very short, rather dense, slender, dark-gray hairs. Frons broad, with almost parallel sides; its breadth approximately the same as its height. Breadth of frontal callosity about 2 1/4 times its height. Lateral velvety patches oval, not very large, the middle one considerably smaller than the others. Antennae: first antennal segment rodlike, 3 1/2-4 times as long as broad, without any noticeable constriction, color reddish except for outer side which is gray; third antennal segment narrow, basal third of platform reddish, the rest black, rod thick. Face with ash-gray bloom and grayish white hairs. Terminal segment of palp light grayish-yellow, strongly thickened and covered with short light-colored hairs. Walls of thorax with pale ash-gray bloom and light-gray

hairs. Wings pale-gray, veins brown. Colored patches on wings rather large, not forming distinct rosettes; posterior margin of wing with a narrow light-colored border. Apical, transverse, light-colored stripe reaches the posterior margin of wing. Halteres have their stalks and basal part of knob dark-colored, the tip of the knob is white. Limbs: femora and tibiae yellowish-gray, the distal $^{2}/_{3}$ of the tibiae are black; middle and hind tibiae with brownish annuli; tarsi black, bases of middle and hind tarsi yellowish-brown. Abdomen gray. The light-colored pattern consists of patches, which are rounded at the side and occur on tergites 1-7, together with median, triangular, patches. These are narrow, light-colored stripes along the posterior margins of the tergites.

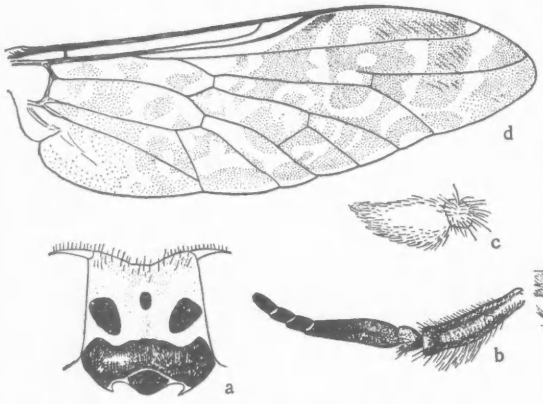


Fig. 9. Chrysozona pavlovskii Hauser, sp.n. female. a) frons; b) antenna; c) palp; d) wing.

Male – Unknown.

Distribution. Nakhichevan, June 9, 1939, 1 female; Ordubad, August 3, 1938, 1 female.

Type female occurs in Zoological Institute Collection, Academy of Sciences, Azerbaidzhan SSR at Baka.

This species is similar to Chr. grandis, but may readily be distinguished as follows: the narrower platform on the first antennal segment; the more distinct pattern on the wings, together with the narrow white strip along their posterior margin. 10-11 mm.

This species is named in honor of Acad. E. N. Pavlovskii.

12. Chrysozona nubilis Hauser, sp. n. (Fig. 10).

Female: Eyes with short black hairs; frons parallel-sides, slightly wider than it is high and covered with gray bloom and rather long delicate gray hairs. Lateral velvet patches small, rounded and distinct. Median patch small. Frontal callosity black, 3 $^{1}/_{2}$-4 times as broad as tall; its lateral margins do not reach the edge of the eyes. Antennae moderately long. First antennal segment reddish with a black extremity, thickened, length/breadth ratio equals 2 $^{1}/_{4}$: 1; second antennal segment black; third segment rather narrow, yellowish-brown at the base with the platform brown and the rod black. Terminal segment of palp gray, moderately inflated, white at the sides. Face with grayish-white bloom and whitish hairs. Walls of thorax with white bloom and whitish hairs. Wings pale brownish-gray, veins yellowish-gray. Light-colored patches rather large, not forming rosettes. Apical transverse strip narrow, reaching posterior margin of wing, along which runs a white border. Halteres white, with a dark patch at the base of the knob. Limbs: femora, yellowish-gray with dark ends, covered with whitish bloom and light-gray hairs; tibiae, light yellow in the middle with black ends, middle tibiae with a faint ring in the middle, hind tibia with dark-colored ring and dark-colored ends; anterior tarsus, black, the other tarsi blackish-brown with yellow proximally. Abdomen gray with a pattern composed of light gray patches at the side of tergites 1-6, and triangular markings on tergites 2-6. There is a narrow, light-colored, posterior border to the tergites; the ventral surface of the abdomen is light gray, except for the last sternite which is dark-colored. 10-11 mm.

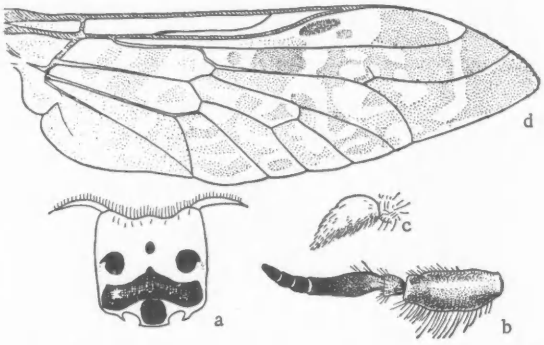


Fig. 10. Chrysozona nubilis Hauser, sp. n. female. a) frons; b) antenna; c) palp; d) wing.

Male – Unknown.

Distribution. Nakhichevan ASSR; Shakhbuzskii region, Batabat, near timberline, August 18, 1939, 1 female.

Type specimen in Zoological Institute collection, Azerbaidzhan SSR at Baka.

LITERATURE CITED

A. V. Bogachev and N. G. Samedov, "Studies on the parasite fauna of Nakh. SSR. (Tabanidae)," Izv. A. N. Azerb. SSR, 5; 66-75 (1949).

E. G. Hauser, "A synopsis of the gad-fly fauna of the Kanlarskii region," Tr. Zoolog. inst. Azerb. filiala (Akad. Nauk SSSR) 10; 135-159 (1939).

E. G. Hauser, "On the Gad-fly fauna of Nagornyi Kara-

bakh," Izv. Azerb. filiala (Akad. Nauk SSSR) 2; 70-75 (1941).
E. G. Hauser, "On the gad-fly (Diptera, Tabanidae) fauna and its phenology in the northwestern Azerbaidzhan," Entom. Obozr. 33, 238-254 (1953).

THE SYRPHID FAUNA (DIPTERA, SYRPHIDAE) OF TRANSCAUCASIA

L. V. Zimina

Zoological Museum, Moscow State University, Moscow

Translated from Entomologicheskoe Obozrenie, Vol. 39, No. 3, pp. 661-665, July-September, 1960

The present paper is a summary of the syrphid fauna of Transcaucasia and is based mainly on the author's collections made in 1955-1957 and 1959 in Armenia and the Nakhichevan ASSR. As a member of the expedition of the Academy of Sciences, Armenian SSR, I had the opportunity to visit many regions of this territory, for which I convey my sincere thanks to our Erevan colleagues, particularly A. S. Avetyan. I must also express my deep gratitude to A. A. Shtakel'berg for his great help in working through the material.

The list of syrphids which I collected has been supplemented with some species from the collections of the Zoological Museum of the Moscow State University; in these cases the surname of the collector is given.

Below I give a list of species, in which only the months of capture (Roman figures) and the plants visited are indicated for the commoner and more widely distributed species. Species recorded for the first time for the Caucasus are marked with an asterisk.

The data on the occurrence of the syrphids have been extracted from the relevant literature (Porchinskii [1876-1877], Paramonow [1926-1927], Shtakel'berg [1926, 1951, 1952, 1955, 1958, 1958a, 1958b, 1959, 1960], Sack [1932], Coe, [1953]), and the information on the nature of Armenia is taken mainly from the collection "The Armenian SSR" [1955].

The relatively small area of Armenia is very diverse as regards its natural conditions. Hence, I consider it worthwhile to give a brief description of the capture localities, grouped in zones.

In the forest zone of north Armenia: Uzuntula, Idzhevan, Dilizhan, Tarsachai Gorge northwest of Dilizhan, Golovino south of Dilizhan, Kirovakan, Vardanlu (Khnzorut) east of Kirovakan, Lermontovo 18 km east of Kirovakan, Stepanavan, Tsakhkadzor (Darachichag), Bzhin; the height of these points above sea-level varies from 700 (Idzheban) to 1800 m (Tsakhkadzor).

In the mountain-steppe of L. Sevan Basin: Basarchegar, Pambak, Nadezhdino (Shorzha) – height 1940 m, and the region of Zod Pass – height more than 2000 m.

In the steppes (Noemberyan, Verin Kerpilu) and semidesert north (Spitak) and central Armenia: Byurakan (1475 m), Inaklyu (1680 m), environs of Erevan, Dzhrvezh 12 km northeast of Erevan, Echmiadzin, Bedi, Karabakhlar, and Asni 7 m north of Armash.

In the dry sparse woodland and mountain steppes of Daralagez and Zangezur: Areni, Arpa Gorge 25 km south of Dzermuk, Shatin, Sisian (near Shaki waterfall), Goris, Vorotan Gorge 15 km north of Goris on the road to Kafan; height of localities 1000-1700 m.

In the forest zone of Daralagez (Gerger, Kavushug) and Zangezur: Shurnukh, Kzldash (Karmrakar) 22 km north of Kafan, Lichk 25 km north of Megri, Lichkvaz; height 1500-2135 m.

In the zone of dry subtropics of south Armenia: Megri (on slopes, in orchards in Megriget Gorge and on banks of Araks), height 400-700 m.

In the Nakhichevan ASSR: mountain steppe – northern slope of Ilandu-Dag (Ilyandag), Kyarki, Arafsa; orchards and remains of riverbank strips of woodland in gorges on west slope of Zangezur Range – Paraga and Chananab.

LIST OF SPECIES

1. Paragus albifrons Flln. Idzhevan, 26/V/55 (1♀); south of Idzhevan, 21/V/1959 (1♀; G. Viktorov). European USSR, Western Europe.
2. P. bicolor F. – VI, Prangos ferulacea Lindl.
*3. P. productus Schin. Pambak, 9/VII/1955 (1♂), on Euphorbia, Central part of Western Europe.
4. P. tibialis Flln. – IV-VII, Draba vesicarium L., Euphorbia, Tamarix.
*5. Spathiogaster ambulans F. Areni, 9/VI/1956 (1♂). A rare species. Caucasus, mountains of Central and Southern Europe.
*6. Baccha elongata F. – IV
*7. B. obscuripennis Mg. – VI
8. Platychirus albimanus F. – VII.
9. Melanostoma mellinum L. – IV-VII, Euphorbia.
10. M. scalare F. – V, VII.
11. Leucozona lucorum L. – VI, VII
12. Scaeva albomaculata Macq. – V-VI, Umbelliferae.

13. Sc. pyrastri L. – VI-VII.

14. Sc. selenitica Mg. – V-VI, Ranunculus, Cruciferae, Umbelliferae.

*15. Syrphus auricollis Mg. Chananab, 28/V/1957 (1♀, on Euphorbia). European USSR, a large part of Western Europe, north Africa.

16. S. balteatus Deg. – V-VII, Ranunculus.

17. S. bifasciatus F. North slope of Ilandu-Dag, 22/V/1957 (1♀); 15 km north of Megri (Lichkvaz) (26♂♂; pairing in sunlight on Rhamnus bushes); Megri, 3/VI/1957 (1♂), 18/IV/1959 (1♂; G. Viktorov); Noemberyan, 30/V/1959 (1♀; G. Viktorov).

18. S. corollae F. – V-VII, Prangos ferulacea, Euphorbia.

*19. S. diaphanus Zett. Indzhevan, 26/V/1955 (1♂); Dilizhan, 27/VII, 29/VIII/1934 (3♀♀; N. Plavil'shchikov. European USSR to north Caucasus, Altai, south Primor'e Western Europe. A rather rare species.

*20. S. grossulariae Mg. – VII.

*21. S. latifasciatus Macq. – VI.

22. S. ribesii L. – V-VI, Ranunculus, Umbelliferae.

23. S. vitripennis Mg. – V-VII, Ranunculus, Umbelliferae.

24. Sphaerophoria menthastri L. – IV-VII, Achillea, Euphorbia, Tamarix.

25. Sph. scripta L. – IV-VIII, Achillea, Crucuferae, Tamarix, Euphorbia, Ranunculus.

*26. Sph. rüppelli Wied. – late IV-VII, Tamarix, Compositae.

*27. Ischiodon scutellaris F. Vorotan Gorge South of Goris, 24/VI/1959 (1♀). Central Asia, Asia Minor Iran, north India.

28. Xanthogramma citrofasciatum Deg. – IV-VI.

29. X. ornatum var. maculipenne Mik. Uzuntala, 27/V/1955 (1♂); Inaklyu, 2/VI/1956 (1♀, on Ranunculus); Shatin, 11/VI/1956 (1♂); Chananab, 28/V/1957 (1♂, on Cruciferae); Megri, 3/VI/1957 (5♂♂, on Potentilla); Vorotan Gorge, 20/VI/1959 (1♀, on Euphorbia). European USSR to the Crimea, the Caucasus, Central Asia, Siberia, Western Europe.

30. Chrysotoxum bicinctum L. – VI-VII, Potentilla, Umbelliferae.

31. Chr. cautum Harr. – IV-VII, Euphorbia.

32. Chr. festivum L. – VI-VII.

*33. Chr. octomaculatum Curt. Uzuntala, 28/V/1955 (1♂, 1♀, in a hornbeam wood); Idzhevan, 23/V/1959 (1♂); Dilizhan, 12/VIII/1934 (1♀; N. Plavil'shchikov). European USSR to the Ukraine and lower Volga, Western Europe.

34. Chr. parmense Rd. Gerger, 16/VI/1957 (1♂, on Potentilla); Chananab, 28/V/1957 (1♂, 1♀, on Euphorbia). Transcaucasia, Central Asia, Italy, Egypt, Asia Minor. A rare species.

35. Rhingia campestris Mg. – V.

36. Orthoneura frontalis Lw. Megri, 18/IV/1959 (2♀♀; E. Antonova). Center and south of European USSR, Transcaucasia, Central Asia, Southern Europe, Asia Minor, Iran.

37. Chrysogaster chalybeata Mg. – VII.

38. Chr. musatovi Stack. Lichk, 10/VI/1955 (1♂, on Ranunculus); Chananab, 28/V/1957 (1♂, on Euphorbia). Caucasus (Teberda), Central Asia (Gissar Range).

39. Chr. tumescens Lw. Basargechar, 5/VII/1955 (2♂♂); Chananab, 28/V/1957 (1♀); Megri, 18/IV/1959 (6♂♂, 5♀♀; E. Antonova). Southeast European USSR, Transcaucasia.

40. Chr. viduata L. – V-VI, Ranunculus.

*41. Cheilosia albitarsis Mg. Kirovakan, 21/VI/1956 (1♀, on Potentilla); Golovino, 1/VI/1955 (1♀, on Ranunculus); Gerger, 15/VI/1957 (1♀, on Potentilla). European USSR, south to the Ukraine and north Caucasus, Siberia, Western Europe, north Africa.

*42. Ch. impressa Lw. – VI, Ranunculus.

*43. Ch. intonsa Lw. Shurnukh, 25/VI/1959 (1♀, on Umbellifera). European USSR, greater part of Western Europe.

44. Ch. mutabilis Fln. – VI, Ranunculus.

*45. Ch. nigripes Mg. – V-VI, Ranunculus, Euphorbia.

*46. Ch. pagana Mg. – VI.

47. Ch. portschinskiana Stack. Stepanavan, 18/VII/1955 (4♀♀, on Umbelliferae); Lermontovo, 28/VI/1955 (1♂, 1♀). Caucasus.

*48. Ch. sareptana Beck Megri, 16, 18/IV/1959 (2♀♀; E. Antonova). Lower Volga, Southern Europe.

49. Ch. schnabli Beck. Golovino, 1/VI/1955 (1♀, on Ranunculus); Kirovakan, 25/VI/1955 (1♀); Sisian (Shaki), 15/VII/1956 (1♀, on Umbelliferae). Caucasus, Southern Europe.

50. Ch. scutellata Mg. – VI.

*51. Ch. soror Zett. Uzuntala, 28/V/1955 (1♀); Idzhevan, 22, 26/V/1955 (1♂, 1♀); Vorotan Gorge, 24/VI/1959 (1♀, on Umbelliferae). Southern half of European USSR, Western Europe.

*52. Ch. variabilis Pz. – V, VII, Umbelliferae.

*53. Ch. vulpina Mg. Golovino, 1/VI/1955 (1♀); south of Idzhevan, 21/V/1959 (1♂, 1♀; G. Viktorov). European USSR from Moscow Region to the Ukraine, Western Europe.

*54. Ch. zetterstedti Beck. Chananab, 28/V/1957 (1♀); Karabakhlar, 10/V/1959 (1♂; G. Viktorov). Central and Northern Europe.

55. Sphegina chinipes Fln. – VI.

56. Pipizella curvitibia Stack. Paraga, 26/V/1957 (1♂). Transcaucasia.

57. P. virens F. – V-VII, Ranunculus.

58. Volucella bombylans L. (var. haemorrhoidalis Zett., var. plumata Deg.; the typical form is absent in the Caucasus). – VI-VII, Allium ursinum L., Astrantia maxima Pall. (Umbelliferae), Germanium.

59. V. pellucens L. – VII.

60. V. zonaria Poda – VI, VIII.

61. Palumbia eristaloides Portsch. Sisian (Shaki), 15/VI/1956 (1♀, on Umbelliferae near river); Gerger, 15, 16/VI/1957 (2♂♂, 1♀, on Umbelliferae near river); Arafsa, 29 30/VI/1959 (2♀♀, on Euphorbia on Slope). A very rare and interesting species, known only from Armenia and the Nakhichevan ASSR.

62. Lathyrophthalmus quinquelineatus F. Dilizhan, 16/VI/1934 (1♀; A. Zhelokhovtsev); Megri, 7/VI/1957 (1♀, on Achillea). Central Asia, Southern Europe, north and east Africa, south Asia. A rare species.

63. Eristalis alpinus Pz. Kirovakan, 26/VI/1955 (1♀). Leningrad and Moscow Regions, Teberda, Chita, Central Europe. A rare species.

64. E. arbustorum L. – V-VII, Euphorbia, Lepidium draba, Archillea.

65. E. horticola Deg. – VII, Scabiosa.

*66. E. jugorum Egg. Stepanavan, 18/VII/1955 (2♀♀); Kirovakan, 26/VI/1955 (1♀); Lermontovo, 29/VI/1955 (1♀); Dilizhan, 22/V/1934 (2♂♂; A. Zhelokhovtsev); Pambak, 9/VII/1955 (1♂); Inaklyu, 2/VI/1956 (1♀, on Ranunculus). Western Europe (Alps). A rare species.

67. E. nemorum L. – VII-VIII, Umbelliferae.

*68. E. pertinax Scop. Stepanavan, 18/VII/1955 (2♀♀, on Umbelliferae). Lower Volga, Caucasus, Western Europe. A rare species.

69. Eristalomyia tenax L. – V-VII, Crataegus, Prangos ferulacea, Euphorbia, Cruciferae, Achillea, Tamarix.

70. Eristalinus sepulcralis L. – IV.

71. Myiatropa florea L. – VIII.

72. Tubifera continua Lw. Basargechar, 5/VII/1955 (1♀). A species described from Siberia. According to collection in Zoological Museum, Moscow State University, recorded from Stalingrad Reg., Sabirabad on R. Araks, Central Asia and Kazakhstan.

73. Lampetia aberrans Egg. Megri, 7/VI/1957 (1♀). Central and Southern Europe, Asia Minor.

74. L. aenea Meig. Kzldash, 15, 18/VI/1955 (4♂♂, 1♀); Shurnukh, 25/VI/1959 (7♂♂, 2♀♀). Caucasus, Central and Southern Europe, north Africa, Asia Minor.

*75. L. graeca Lw. Shurnukh 25/VI/1959 (1♂). Southern Europe, Asia Minor.

76. L. longicornis Sack. Arafsa, 30/VI/1959 (1♂, on Euphorbia). Armenia.

*77. L. nana Sack. Shatin, 12/VI/1956 (1♂); Gerger, 15/VI/1957 (2♂♂); Arafsa. 30/VI/1959 (1♀, on Euphorbia). Kurdistan.

*78. L. ruficornis Mg. Tsakhkadzor, 30/V/1956 (1♂, 1♀, on Ranunculus); Gerger, 15/VI/1957 (1♂); 15 km north of Megri, 15/V /1957 (2♂♂, 1♀, on Ranunculus). Caucasus, Central and Southern Europe.

79. L. spinipes F. (forma typica et var. avidus Rd.). Pambak, 8/VII/1955 (2♀♀, on Euphorbia); Lichk, 3/VII/1956 (1♀); Spitak, 27/VI/1956 (1♂); Paraga, 26/V/1957 (1♂); Gerger, 16/VI/1957 (1♂); Megri, 7/VI/1957 (1♀, on Achillea); Vorotan Gorge, 22, 24/VI/1959 (3♂♂, on Euphorbia). Caucasus, Central and Southern Europe, north Africa Asia Minor.

80. L. velox Lw. (forma typica, var. armeniaca Par., var. anathema Par.). Ashtarak District, Alagez, 2000 m, 10/VI/1952 (1♂, 1♀; I. Darevskii); Areni, 9, 10/VI/1956 (2♀♀, on Prangos ferulacea); 25 km south of Dzhermuk, 14/VI/1956 (2♂♂, 2♀♀); Paraga, 26/V/1957 (16♂♂, 15♀♀, on Euphorbia); Chananab, 28/V/1957 (1♀, on Euphorbia); Karabakhlar, 13/V/1959 (1♀; G. Viktorov); Byurakan, 7/VI/1959 (1♀; G. Viktorov). Caucasus, Southern Europe, Asia Minor. A rare species.

*81. Exmerodon fulcratum Beck. Chananab, 28/V/1957 (1♂); Asia Minor, Iran.

82. Arctophila bequaerti H.-B. Dilizhan, 22/VIII/1934 (1♂; N. Plavil'shchikov). Caucasus, Southern Europe (Balkan Pen.), Asia Minor. A rare species.

83. Penthesilea oxyacanthae Mg. Stepanavan 18/VII/1955 (1♂, on Umbelliferae); Kirovakan, 26/VI/1955 (1♀). Caucasus, central and southern Western Europe. A rare species.

84. P. portschinskyi Stack. Kirovakan, 26/VI/1955 (1♀). Caucasus. A very rare species.

*85. Zelima segnis L. – VI.

*86. Brachypalpus chrysites Egg. Megri, 18/IV/1959 (3♂♂; E. Antonova and G. Viktorov). Caucasus, central part of Western Europe. A rare species.

87. Syritta pipiens L. – IV-VII, Euphorbia, Lepidium draba, Tamarix, Achillea.

*88. Myiolepta luteola Gmel. Stepanavan, 18/VII/1955 (1♂). Western Europe. A rare species.

89. Temnostoma vespiforme L. – VI.

90. Spilomyia diphthalma L. Dilizhan, 1/VIII/1934 (1♂; N. Plavil'shchikov). European USSR, Caucasus, Siberia, Western Europe.

*91. Eumerus annulatus Pz. Goris, 17/VII/1956 (1♂). First record of species for USSR, Western Europe.

*92. E. falsus Beck.. Areni, 9/VI/1956 (1♂). Asia Minor.

93. E. richteri Stack. Arafsa, 30/VI/1959 (1♀). Transcaucasia.

94. E. tarsalis Lw. Spitak, 27/VI/1956 (1♀). Armenia, Western Europe.

*95. E. tricolor F. Noemberyan, 29/V/1959 (1♂; E. Antonova); Verin Kerpilu, 31/V/1959 (1♂; G. Viktorov). European USSR, central and Southern parts of Western Europe.

*96. Microdon eggeri Mik. Dilizhan, 22/VI/1934 (1♀; A. Zhelokhovtsev). European USSR, Siberia, south Primor'e Western Europe.

97. M. mutabilis L. Idzhevan, 26/V/1955 (1♀); Kirovakan, 21/VI/1956 (2♂♂); Megri, 13/V/1957 (1♀). European USSR south to the Crimea, Caucasus, north Kazakhstan, Siberia, Western Europe.

98. Cerioides caucasica Param. Echmiadzin, 27/V/1956 (1♀, on Lepidium vesicarium); Megri, 13/V/1957 (1♀, on Tamarix). A very rare species. Recorded only from Transcaucasia.

SUMMARY

An account is given of the syrphid fauna of Transcaucasia and 98 species collected in Armenia and Nakhichevan ASSR are listed. Among the species 34 are recorded for the first time for the Caucasus (they are marked off in the list). Eumerus annulatus Pz. is recorded for the first time in the USSR territory. A brief description of the localities is given; for many species the plants on which they were collected are indicated.

LITERATURE CITED

A. O. Marukyan, E. M. Murzaev and S. N. Ryazantsev (Eds.), Coll.: The Armenian SSR [in Russian] (Geografgiz, 1955).

A. I. Porchinskii, "Material for a history of the fauna of Russian and the Caucasus. Bumble-bee flies," Tr. Russk. Éntom. Obshch. 10, 102-197 (1876-1877).

A. A. Shtakel'berg, "Dipteran fauna of Armenia," Russk. Éntom. Obozr. 20, 65-68 (1926).

A. A. Shtakel'berg, "Diptera," Kondara Gorge. Syrphidae [in Russian] pp. 137-138 (1951).

A. A. Shtakel'berg, "New Syrphidae (Diptera) of the palaearctic fauna," Tr. Zool. Inst. AN SSSR 12, 350-400 (1952).

A. A. Shtakel'berg, "Palaearctic species of the genus Penthesilea Mg. (Diptera, Syrphidae)," Éntom. Obozr. 34, 340-349 (1955).

A. A. Shtakel'berg, "Materials on the dipteran fauna of Leningrad Region. IV. Syrphidae (Diptera)," Tr. Zool. Inst. AN SSSR 21, 192-246 (1958a).

A. A. Shtakel'berg, "Diptera," Animal World of the USSR.V. Mountain Regions of the European USSR. The Caucasus [in Russian] pp. 288-317 (1958b).

A. A. Shtakel'berg, "Palaearctic species of the genus Chrysogaster Mg. (Diptera, Syrphidae)," Éntom. Obozr. 38, 4, 898-904 (1959).*

A. A. Shtakel'berg, "New species of Syrphidae (Diptera) of the Caucasus," Éntom. Obozr. 39, 2, 438-449 (1960).*

R. L. Coe, Handbooks for the identification of British Insects, Diptera-Syrphidae, Vol. X, 1, 1-98 (1953).

S. J. Paramonow "Fragmente zur Kenntnis der Dipteren-Fauna Armeniens," Societas entomologica 41, 33-34, 38-39, 44, 46-47 (1926); 42 : 2-4, 9-11, 15-16, 19-20, 24 (1927).

P. Sack, Syrphidae. In: E. Linder, Die Fliegen der paläarktischen Region; 1-451 (1932).

* Original Russian pagination. See C. B. translation.

THREE NEW SPECIES OF PLECOPTERA FROM THE ALTAI AND SAYAN MOUNTAINS

Yu. I. Zapekina - Dul'keit

"Stolby" State Nature Reserve

Translated from Éntomologicheskoe Obozrenie, Vol. 39, No. 3, pp. 666-670, July-September, 1960

In 1948, G. D. Dul'keit and the author began their collecting of stone-flies (Plecoptera) in the Altai Mts. This was continued at a later date in the Sayan Mts. and the examination of material from these two localities yielded a series of new species.

The imaginal phases described below represent three new species which are characteristic of the stone-fly fauna of small rivers in the mountain taiga. They also occur along the upper tributaries of larger rivers. The species were collected from the basin of the Chulyshman River, which flows into Lake Teletsko in the Altai Mts., and from the north spur of the Sayan Range in the basin of four tributaries of the R. Enisei (at an elevation above the town of Krasnoyarsk), these tributaries being the Basaikhi, Bolshoi Sliznevoi, Mana and Tyba respectively.

Two of the species described, i.e., Arcynopteryx sajanensis sp.n., and A. altaica, sp.n., belong to the family Perlodidae; one, i.e., Capnia lepnevae, sp.n. to the family Capniidae.

The types of these species are preserved in the Zoological Institute, Academy of Sciences, USSR.

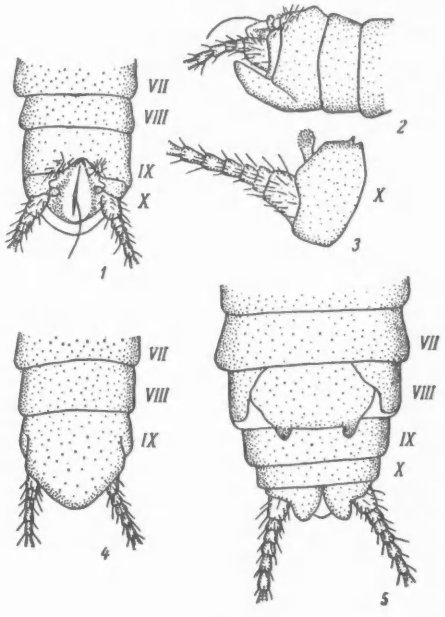
Arcynopteryx sajanensis Zapekina – Dulkeit, sp.n. (Figs. 1-5)

The description of this species is based on an examination of 136 examples, 63.2% of which were long-winged males and females and 36.8% short-winged males and females. The long-winged individuals consisted of 59 males and 27 females, the short-winged individuals of 33 males and 17 females. When the wings of the short form were folded, their species reached the posterior margin of the second and third abdominal segment in the males and the posterior margin of the fourth of fifth segment in the females.

Length of body in females 15.0-21.0 mm, in males 12.0-18.0 mm. Length of forewings in long-winged females 16.5-19.0 mm, in males 12.0-14.5 mm. Dimensions of hindwings in females 37.0-39.5 mm, in males 27.0-30.5 mms. Length of forewings in short-winged females 5-6 mm, in short-winged males 3.5-5.0 mm.

The body coloration is a dark-brown dorsally with a light colored patch between the eyes extending to the posterior margin of the head; among the lighter colored individuals this patch extends laterally to the base of the antennae. There is an M-shaped figure on the head, which in the females is not always as distinct as in the males (especially where the latter are light-colored). A light-colored median stripe is found on the pronotum of some individuals and may also occur on the scutum. Wings light-brown with the veins of darker color.

Abdomen of male dark-brown dorsally, yellowish brown ventrally. In the middle of the posterior margin of tergite IX is a rather deep notch (c.f. Fig. 1); in some individuals this notch is half as long as the



Figs. 1-5. Arcynopteryx sajanensis, sp.n. 1) end of abdomen in male (dorsal view); 2) end of abdomen in male (lateral view); 3) lateral part of tergite X in male; 4) end of abdomen in male (ventral view); 5) end of abdomen in female (ventral view); VII, VIII, IX, X) abdominal segments.

whole tergite. The elongate appendages arising laterally from the tenth tergite resemble those of Arcynopteryx compacta (Klapalek, 1912), but differ from them in certain structural details. The distal ends of the appendages are thickened and bear short spinules (Figs. 1, 2, 3). At the base of the tenth tergite there are lateral spines or toothlets (Fig. 3). The supra-anal lobe is membranous, with a projecting seta, which is bent in a postero-ventral direction- a point of distinction from A. compacta, in which this seta is always directed postero-dorsally. (Klapalek 1912; Brinck, 1952; Illies, 1955). The subgenital plate in the male is large, its posterior margin reaching to the end of the abdomen (Fig. 4). Subgenital plate in female broad, comprising almost the whole of sternite VIII; its posterior edge is straight with wide lobes at the side (Fig. 5).

Distribution. The species is known from the northern parts of the East and West Sayan range, in the basin of the Mana and Tuba rivers.

Material. From Bolshoi Arzybei river (left tributary of R. Mana), Aug. 24, 1953, 10 males, 12 females; June 24, 1955, 13 males, 5 females. Malaya Shinda river (in the basin of R. Tuba), June 28, 1955, 8 males, 2 females. Upper stretches of R. Zhadeiba (in the Mana basin), July 6, 1955, 17 males, 1 female. River Bol'shaya Dezo, (middle stretches), July 7, 1955, 44 males, 24 females. (G. D. Dul'Keit).

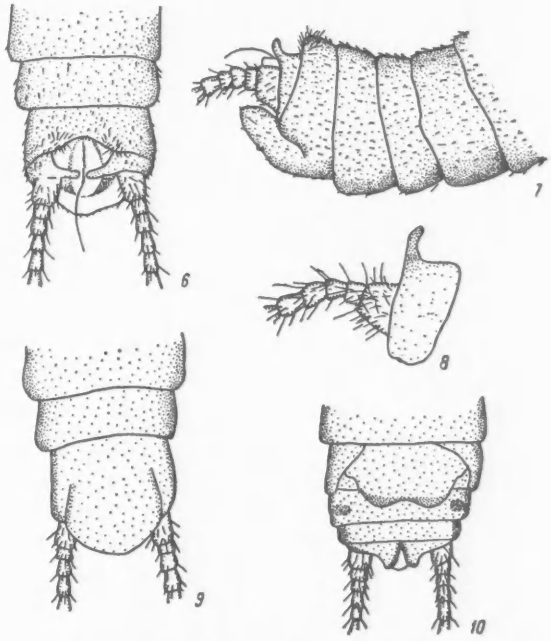
Arcynopteryx altaica Zapekina – Dulkeit, sp. n. (Figs. 6-10).

The author examined 37 examples of this species; 17 long-winged males, 9 long-winged females and 11 short-winged males.

Body length in females 16.0-18.0 mm, in males 12.0-14.0 mm. Length of female forewing 15.5-16.5 mm; length of forewing in long-winged males 12.5-13.0 mm, in short-winged males 4.5-6.0 mm. No short-winged forms were encountered among the females.

The body coloration is dark-brown. There is a light-colored patch between the eyes which extends to the posterior margin of the head. Sometimes the head is paler in color and then the patch, which extends to the base of the antennae is not clearly separated from the rest of the head.

Pronotum is wider than it is long and possesses a light-colored median stripe, which takes up one fifth of the pronotal width; in light-colored examples this stripe is not very distinct. Wings pale-brown with darker colored veins.



Figs. 6-10. Arcynopteryx altaica, sp.n. 6) end of abdomen in male (dorsal view); 7) end of abdomen in male (lateral view); 8) lateral portion of tergite X in male (side view); 9) end of abdomen in male (ventral view); 10) end of abdomen in female (ventral view).

Posterior margin of tergite IX with a shallow notch in some individuals but not in others. The notch is, however, never deep as in Arcynopteryx compacta and A. sajanensis sp.n.

The lateral appendages on tergite X are elongate and of simple form (Figs. 6, 7 and 8), thus differing in structure from those of A. compacta (Klapalek, 1912) and A. sajanensis sp.n. Supraanal lobes membranous with long projecting setae, which are directed postero-ventrally, as in A. sajanensis. Posterior end of abdomen in male has a simple structure (Fig. 9).

Subgenital plate of female large, with a shallow notch in its posterior margin and short, triangular lobes on each side of the notch (Fig. 10).

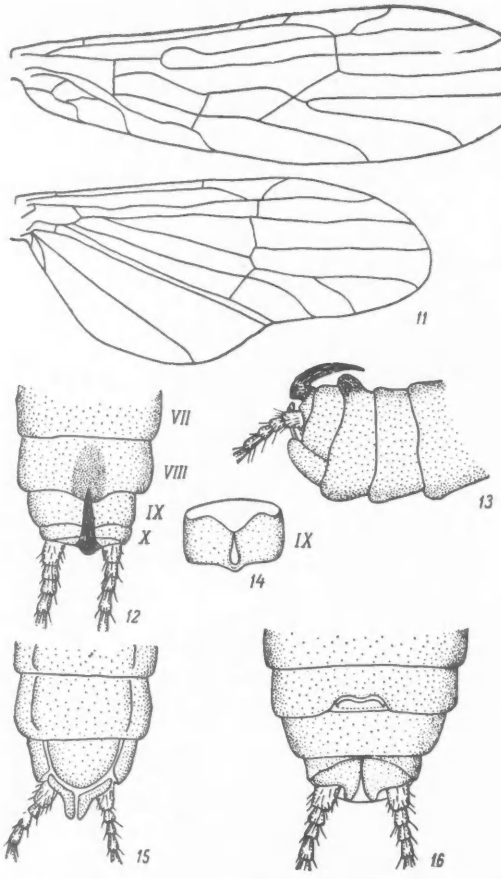
The species described above differs from other species in the structure of its ninth tergite, in the form of lateral portions of its tenth tergite and in the shape of the subgenital plate on the eighth sternite of the female.

Distribution. Central Altai, in the basin of the River Chulyshman. The northern parts of Eastern and Western Sayan, in the basins of the Mana and Tuba rivers.

Material. River Uzun – Oëk (Basin of R. Chulyshman), July 13, 1949, 9 males, 4 females. River Malaya Shinda (tributary of R. Tuba), July 2, 1955, 1 male. River Bol'shaya Dezo (tributary of R. Mana). July 7, 1955, 6 males, 5 females. River Malyi Arzybei (tributary of R. Mana), July 8, 1955, 6 males. (G. D. Dul'keit).

Short-winged and long-winged individuals were found in all our collections.

Capnia lepnevae Zapekina – Dulkeit, sp.n. (Figs. 11-16)



Figs. 11-16. Capnia lepnevae, sp.n. 11) venation of wings; 12) end of abdomen in male (dorsal view); 13) same (lateral view); 14) abdominal segment IX of male (dorsal view); 15) end of abdomen in male (ventral view); 16) end of abdomen in female (ventral view).

The author examined 110 examples of this species of which 62 were females and 48 males. Body length in female 5.5-6.5 mm., in male 4.5-6.0 mm. Length of female fore-wing 6.0-7.0 mm., length of male fore-wing 3.5-5.5 mm. The wing spread in the female is 12.5-14.5 mm, in the male 7.0-11.5 mm. Among the males, forms were encountered with rather shorter wings.

The body coloration is dark-brown, almost black. Limbs dark-brown. Pronotum narrower than the posterior margin of the head, almost square, with a sharply defined groove along the front and back edges. Wings smoky with brownish veins. There are 1-2 transverse veins at the distal end of the costal field (Fig. 11).

This species differs from the groups comprising Capnia atra (Brinck, 1952; Illies, 1955), C. nigra (Despax, 1951; Brinck, 1952; Illies, 1955), C. ahngeri (Koponen, 1949) and C. pygmaea (Brinck, 1952), in having a black, elevated tubercle on tergite VIII, instead of on tergite VII as in the other species (Fig. 12, 13). In the middle of tergite IX there is a narrow cleft, which widens as it approaches the posterior end of the tergite and which terminates abruptly near the anterior margin Fig. 14. The tenth tergite is cleft longitudinally, the two halves being united posteriorly by a slender chitinous bridge. The supraanal organ is curved antero-dorsally, is strongly sclerotinized and tapers evenly towards its distal end (Fig. 12, 13); it has a narrow groove along its dorsal surface. The tip of the abdomen in the male (Fig. 15) has a simple, straightforward structure, as seen in ventral view.

Subgenital plates of female short with light-colored, ventral projections from their posterior margin (Fig. 16).

The species described above differs from other members of the genus in the presence of a black protuberance on the eigth tergite, in the structure of the supraanal organ in the male and in the appearance of the subgenital plates of the female.

The species is named after S. G. Lepneva, who has done so much research on the aquatic fauna of the Altai and Sayan mountain taiga.

Distribution. Northern parts of Eastern Sayan, the "Stolby" State Nature Reserve (situated between the Bazaikha and Mana Rivers, near the town of Krasnoyarsk).

Material. Upper reaches of the R. Bol'shoi Arzybei (tributary of R. Mana), June 25, 1955, 22 females. Upper reaches of R. Kaltat (tributary of R. Bazaikha), May 27, 1955, 18 males, 7 females; May 11, 1957, 12 males, 3 females. R. Sarala (tributary of R. Mana), May 2, 1958, 18 males, 46 females. River Bolshaya Slizneva, May 21, 1956, 2 females. Beselyi Brook (tributary of R. Bazaikha), June 8, 1956, 2 females (G. D. Dul'Keit, Yu. I. Zapekina-Dul'Keit).

This species is widely distributed in the cold streams and rivers of the mountain taiga. It was encountered by the author at altitudes between 150 and 950 m and above. The flight of adult insects began at the end of May; single individuals occurred as late as June 25th.

SUMMARY

Two new species of Plecoptera of the family Perlodidae and one of the family Capniidae collected in the USSR (the Mountain Altai and Sayan Mountains) are described. The types of the species described are kept in the Zoological Institute, Academy of Sciences, USSR.

1. Arcynopteryx sajanensis Zapekina-Dulkeit, sp.n. (Fig. 1-5). Body length ♀, 15.0-21.0 mm, ♂ 12.0-18.0 mm. Wing-spread ♀, 37.0-39.5 mm, ♂ 27.0-30.0 mm.

♂. Posterior margin of tergite IX with rather deep groove. Stretched appendages of lateral sections of tergite X resemble those of Arcynopteryx compacta McL., differing in form and structure. Supraanal lobe membraneous with bristle exposed and bent back and down as compared with A. compacta, in which this bristle directed up and forward. ♀. Subgenital plate broad, occupy nearly the whole tergite VIII, posterior margin straight with obtuse three-cornered folds on sides.

The northern part of Eastern and Western Sayan Mountains, basins of the Yenisei river tributaries, the Mana and the Tuba. Flight in June-July.

2. Arcynopteryx altaica Zapekina-Dulkeit, sp. n. (Fig. 6-10). Body length ♀, 16.0-18.0 mm, ♂ 12.0-14.0 mm. Forewing length ♀, 15.5-16.5 mm, long-winged ♂, 12.5-13.0 mm, short winged ♂, 4.5-6.0 mm.

♂. Posterior margin of tergite IX with faint groove. Appendages of lateral sections of tergite X stretched, differing in their structure from those of Arcynopteryx compacta and A. sajanensis. Supraanal lobe membraneous, with exposed thin bristle, directed back and down. ♀. Subgenital plate broad with small groove at the posterior margin and with short obtuse-three-cornered lobes on sides of the groove.

The Central Altai, the Tshulyshman river. The Northern part of Eastern and Western Sayan Mountains, basins of the Mana and Tuba rivers. Flight in July.

3. Capnia lepnevae Zapekina-Dulkeit, sp.n. (Fig. 11-16). Body length ♀, 5.5-6.5 mm, ♂ 4.5-6.0 mm. Wing-spread ♀, 12.5-14.5 mm, ♂ 7.0-11.5 mm.

♂. Black tubercule on VIII abdominal tergite present. In Capnia atra, C. nigra, C. ahngeri, C. pygmaea tubercule present on VII tergite. Along tergite IX narrow cleft present. Supraanal organ bent up forward, strongly sclerotized, tapering nearly evenly to

the distal end, with narrow longitudinal groove dorsally ♀. Subgenital plate short with exposed smooth plate.

The Northern part of Eastern Sayan Mountains, basins of small tributaries of the Yenisei river near Krasnoyarsk. Flight in May-June.

LITERATURE CITED

P. Brinck. "Bäckslandor," Plecoptera, Svensk Insektfauna, 15, 1-126 (1952).

R. Despax, " Plécoptères," Faune de France, 55, 1-280 (1951).

J. Illies," Steinfliegen oder Plecoptera. Die Tierwelt Deutschlands u. der angrezenden Meeresteile, " 43, 1-150 (1955).

J. Koponen, "Neue oder wenig bekannte Plecoptera," Annales Entom. Fennici, 15, 1, 1-21. (1949).

F. Klapalek, "I. Fam. Perlodidae," Coll. Zoll. Selys Longchamps, 4, 1-193 (1912).

EAST-ASIATIC SPECIES OF WEEVILS (COLEOPTERA, CURCULIONIDAE) IN THE FAUNA OF THE USSR

M. E. Ter-Minasyan

Zoological Institute, Academy of Sciences, USSR, Leningrad
Translated from Entomologicheskoe Obozrenie, Vol. 39, No. 3, pp. 671-673, July-September, 1960

While processing material from various districts in the south of the Far Eastern region over the last few years, the author of the present paper has made some interesting finds of weevil species of East Asian origin which are rare or as yet not recorded for the USSR fauna. Some new data on these species are presented below.

Subfamily PRIONOMERINAE

Ochyromera japonica Roel. (= Minyrus japonicus Roel.).

Khabarovsk, June-July, 1905 (1 ♀; Gudzenko); Maritime Province, Sedanka, Aug. 14, 1959 (1 ♂; Zemlina and Anufriev).

This species was described by Roelofs (1874) from Japan and erroneously ascribed by him to the genus Minyrus Schönh. Marshall (1935) ascribed this species to the genus Ochyromera (Pascoe, 1874); judging by the illustration in this work, our species actually does belong to this genus. In view of the inaccessibility of the original description, we are here presenting a short description of our specimens.

Yellowish brown, with darker brown longitudinal stripe medially on pronotum and along suture, fairly densely and evenly covered with close-set yellowish setae. Beak curved, equal in length to pronotum, stout, with longitudinal median glabrous line, more densely punctate laterally in the male, or somewhat longer than pronotum, distinctly stouter than in male, glabrous, sparsely punctate, and shiny in the female. Antennae inserted at anterior third of beak in male and before middle in female; first segment of funicle distinctly stouter and almost twice as long as second elongate segment of funicle; remaining segments transverse. Head with strongly projecting, large, coarsely faceted eyes. Frons between eyes narrow, depressed, with longitudinal lines. Pronotum feebly transverse, dorsally deplanate, laterally prominently rounded, the greatest width at middle, slightly narrowing basally, strongly narrowing apically, with a constriction along sides before apex. Elytra considerably wider than pronotum, with distinctly prominent humeri, almost twice as long as total width at humeri, with jointly rounded apices, with a distinct preapical tubercle between third and fifth intervals, and with straight rows of punctate striae, the intervals between them flat, very finely punctate. Anterior coxae situated closer to posterior margin of prothorax than to anterior, contiguous; anterior femora stouter and more masssive than others, with strong tooth and tuft of setae behind tooth (between tooth and apex of femur); tooth on anterior femora with entire, non-serrate edges, which, as Voss (1935) indicates is a fundamental character separating the East Asian genera of Prionomerinae from the Neotropical. Anterior tibiae strongly bent, with tooth at outer margin of apex closer to middle; claws not fused, simple, without tooth. Middle coxae separated by short, right-angled projection of mesosternum. Middle and posterior femora more slender than anterior, their tooth smaller than that on anterior femora but still fairly strong; no tuft of setae behind tooth. Length 4.5 mm.

Up to the present time 11 species of this genus are known from southern and eastern India, China, Burma, and the island of Borneo.

Subfamily MAGDALINAE

Tribe CARCILIINI Voss (1958)

CARCILIA Roelofs (= Paramagdalis T. -M., syn. nov.)

This genus was described by Roelofs (1874) from Japan with one species, C. strigicollis Roel. (idem). Faust (1882) erroneously recorded C. strigicollis Roel. from the Amur. The next described species of the genus, C. mesosternalis, was described by Heller (1931) from Taiwan, with an indication that the genus Carcilia is located after Magdalis in the classification. A new species freyi was described by Zumpt (1932) from Japan and ascribed by him to the genus Tenguzo Kôno in the "Lixine" group. Zumpt (1938) also described the species C. marshalli from Yunan (China), giving a key to the species of the genus in which C. strigicollis Roel. was recorded from the Amur region. C. granicollis Marsh. (Marshall, 1948) was described from Burma and Assam. The systematic position of the genus in the family is disputable. Heller (1941) ascribes it to the tribe Hylobiini in Marshall's (1932) sense, while

Marshall (1948) places it in the Pissodinae and Voss (1953, 1958) places it in the Magdalinae, where it is retained in the present paper.

The genus Carcilia Roel. is represented in the fauna of the Maritime Province (Primorskii Krai) of the USSR by C. tenuistriata Hell., 1941; the synonymy of this species must include one described by the author (Ter-Minasyan, 1956) as Paramagdalis fortipes T. -M. (syn. nov.).

Subfamily ZYGOPINAE

Euryommatus odiosus Faust.

Maritime Province, Botchi R., July 31, 1931 (1 ♂; Emel'yanov); Sedanka, July 5, 1914 (6 ♂♂, 5♀♀; Berger); Kamenushka, Shkotov District, Aug. 17, 1937 (1 ♀; A. Monchadskii); Maritime Prov. (1♂, 1♀; L. Ivliev). On Manchurian fir (Abies holophylla Maxim.).

Described by Faust (1882) from the Amur Region. Faust (1883) devoted a work to the systematic position of the group; descriptions of new species from China and Japan were given in a work by Zumpt (1937). The food plant of Euryommatus odiosus Faust is recorded for the first time.

SUMMARY

A redescription is given of Ochyromera japonica Roel., found in the Ussuri Region* for the first time. The following synonymy is given: Paramagdalis fortipes T. -M. (1956) = Carcilia tenuistriata Hell. (1941). The food plant of Euryommatus (Lamyrus) odiosus Faust is indicated to be Abies holophylla Maxim.

LITERATURE CITED

J. Faust, "Rüsselkäfer aus dem Amurgebiet," Deut. Entom. Zeitschr. 26, 11, 275. (1882).

M. E. Ter-Minasyan, "New weevils from the Maritime Province," Zoolog. Zhurn. 35, 3, 394 (1956).

J. Faust, "Die Gruppe der Coryssomerides Lac. Stettin. Entom. Zeitung, 44, 10-12, 473 (1883).

K. Heller, Sauter's Formosa-Ausbeute (Curculionidae). Wien. Entom. Zeitung, 2, 99 (1931).

K. M. Heller, "Peribleptus Schönh. und Carcilia Roelofs (Col. Curc., Hylobiinae)," Entom. Blätt, 37, 2, 78-83 (1941).

G. A. K. Marshall, "Notes on the Hylobiinae (Col., Curc.)," Ann. Mag. Nat. Hist., 9, (10), 341-355 (1932).

G. A. K. Marshall, "New Curculionidae (Col.) from Tropical Africa, with Notes on Synonymy, etc.," Ann. Mag. Nat. Hist., 15, (10) 89, 516 (1935).

G. A. K. Marshall, "Entomological results from the Swedish expedition 1934 to Burma and Britisch India – Coleoptera, Curculionidae," Novit. Zool. 42, 3, 410 (1948).

F. P. Pascoe, "Contribution towards a knowledge of the Curculionidae," IV. Journ. Linn. Soc. Zool. London 12, 31-32 (1874).

W. Roelofs, "Curculionides recueilles au Japon par M. G. Lewis," Ann. Soc. Entom. Belg. 17 : 152-155 (1874).

E. Voss, "Fünf Rüssler aus den Tribus Prionomerini und Anthonomini von Java. (Col., Curc.)" Entom. Blätt, 31, 6, 228 (1935).

E. Voss, "Über einige in Fukien (China) gesammelte Rüssler. IV (Col.,Curc.)," Entom. Blätt, 48, 2, 70-73 (1953).

E. Voss, "Ein Beitrag zur Kenntnis der Curculioniden im Grenzgebiet der Orientalischen zur Palä̈arktische Region (Col., Curc.)," Decheniana, Beihefte 5, 38-39 (1958).

F. Zumpt, "Neue Rüsselkäfer aus dem Japanischen Reich und Bemerkungen zu einigen Hylobius (Pagiophloeus) Arten. Koleopterol," Rundschau 18, 126 (1932).

F. Zumpt, "Neue ostpaläarktische Rüsselkäfer aus der Sammlung des Herrn G. Frey," Entom. Blätt, 33, 1 : 25-28 (1937).

F. Zumpt, "Uebersicht über die derzeit bekannten Carcilia-Arten mit Beschreibung einer neuen Art. Koleopterol," Rundschau, 23: 23 (1938).

* Ussuri Region of Maritime Province.

ON THE TAXONOMY AND DISTRIBUTION OF BARK BEETLES (Coleoptera, Ipidae) IN THE USSR AND ADJACENT COUNTRIES

B. V. Sokanovskii

Translated from Entomologicheskoe Obozrenie, Vol. 39, No. 3, pp. 674-678, July-September, 1960

I. NOTES ON THE USSR BARK-BEETLE FAUNA

1. Scolytus jaroschevskyi Schev. (= granulifer Rtt.). This species, described from a single specimen without statement of tree species, has for a long time aroused doubt regarding its independence. Discussions by Reitter (1913) and Eggers (1914) in connection with the description of S. granulifer Rtt. did not clarify this question; for example Reitter (1913) himself, on page 18, writes that S. jaroschevskyi Schev. has a "large spur" on the second abdominal segment, and in the same work on page 25 he states that this spur is "short, conical." In the description of S. granulifer Rtt. by V.N. Stark (1952) in "Fauna of the USSR" an error was admitted on p. 146: the phrase "on the middle of the second abdominal segment there is a protuberance" should read "on the middle of the apex of the second abdominal segment there is a protuberance."

Thanks to the kindness of S.A. Mirzoyan I had the opportunity to examine a series of scolytids, collected by him from oleaster in Armenia, which turned out to be typical S. jaroschevskyi Schev.; S. granulifer Rtt. is a synonym. The description of Reitter (1913) should be supplemented: in the female the frons is convex, with a long sharp keel transversing the entire frons; punctures on the pronotum fine, not contiguous; elytra with distinct furrows; size 4-5 mm. In connection with this the synonym S. granulifer Rtt. (Sokanovskii, 1954) should be considered an error.

According to the reports of S. A. Mirzoyan S. jaroschevskyi Schev. is encountered universally in Armenia and is a serious pest of oleaster.

Proventriculus of Dryocoetes ramicola Rtt.

S. kostini Sokan. (Sokanovskii, 1954) should be considered a local form of S. jaroschevskyi Schev., encountered in northern Kazakhstan on oleaster. According to the reports of I.A. Kostin this species is rare there, and is not of economic importance. Accordingly S. kostini var. rufostriatus Sokan. (Sokanovskii, 1956) is an intermediate form, distributed from Turtkul to Tadzhikistan.

Thus the synonomy of this species should be as follows:

S. jaroschevskyi Schev. 1904,
S. granulifer Rtt. 1913,
var. kostini Sokan. 1954,
var. rufostriatus Sokan. 1956.

2. Scolytus zaitzevi But. Discovered by I.V. Tropin in the Leninsk Forest District of the Aleksandrovsk District in the Rostov Region, on elm. The female of this species, undescribed by Butavitsch (1929), is distinguished from the male only by the absence of blister-like protuberances and tufts of bristles on the last abdominal segment, the apical end of which is raised and has the appearance of a broad protuberance. With this feature, and also with the glossier elytra and the absence of a sharp tubercle on the second abdominal segment, the females of this species may be distinguished from S. kirschi Skal., to which the species is very close.

3. Scolytus rugulosus Ratz. var. intermedius var. n. Distinguished from the typical form by a broader body and chestnut coloration. Elytra with rows of regular, fine punctures and with black bristles, a distinct fringe forming at the edges of the elytra. Frons with long dense bristles. Collected by I.K. Makhovskii in Tashkent from velvet almond.

4. Polygraphus punctifrons Th. var. bicolor var. n. Distinguished from the primary form by its black, lustrous head and pronotum, and also by the red elytra with a sparse covering of scales and bristles. Ivanov, on spruce.

5. Polygraphus laticollis Egg. We discovered this species in the collections of G.O. Krivolutskaya from Sakhalin among P. sachalinensis Egg., with one specimen from spruce; it is distinguished by a transverse pronotum;

length of elytra 2 1/2 times the length of the pronotum. The determination requires checking.

6. Lymantor coryli Perr. Discovered by S.G. Plugar in the Irkutsk District, on bird cherry.

7. Dryocoetes ramicola Rtt. This species was described by Reitter (1894) as D. ramicola, but Reitter later placed it in the genus Taphrorychus (Reitter, 1913). According to its general appearance this species stands closer to Dryocoetes, as not a single species of Taphrorychus has an elytral declivity like D. ramicola. The tuft of bristles on the frons of females in D. ramicola, and the pronotum are also atypical for Taphrorychus. Following studies on the construction of the proventriculus in the material of V.V. Lezhavy in Kutaisi from chestnut, it was clear that this species is a typical representative of the genus Dryocoetes (see drawing; compare: Sokanovskii, 1930). In our collection there are specimens of this species compared by Eggers with Reitter's type. The following should be synonyms of this species:

Dryocoetes ramicola Rtt. 1894,
Taphyrorychus ramicola Rtt. 1913,
Dryocoetes pusillus Egg. 1933.

8. Dryocoetes autographus Ratz. var. sachalinensis, var. n. Distinguished from the basic form by the elongated and deep body, and by the parallel sides of the pronotum. Collected in quantities in Sakhalin by G.O. Krivolutskaya.

9. Dryocoetes baicalicus Rtt. var ursus, var n. Black, slightly shiny. Pilous cover on the pronotum and on the lower part of the body dense, matted. Elytra with long protruding bristles, occuring in regular rows. Frons completely hidden by bristles. Found by I.A. Kosten in southern Kazakhstan on spruce.

10. Dryocoetes minor Egg., 1903 (= sardus Strohm., 1912). Recorded for the Transcaucasus, including Lenkoran (Eggers, 1912; Reitter, 1913; Vinogradov-Nikitin and Zaitsev, 1926), but the latter author, because of insufficiency of material, doubts the independence of this species.

11. Pityophthorus sichotensis Kur. Found by M.A. Lure in Lemerovo and A.S. Rozhkov in the Irkutsk District on spruces.

12. Pityogenes baicalicus Rtt. Discovered by I.A. Kostin in southern Altai on pines.

13. Pityogenes saalasi Egg. var. niger var. n. Entirely black specimens attaining a size of 3.5 mm. According to their appearance they are close to P. perfossa Bees. (= spessivtzevi Leb.). Found by V.P. Grechkin in the Irkutsk Region, along with P. chalcographus L., on spruce.

II. ON THE BARK-BEETLE FAUNA OF THE MONGOLIAN PEOPLE'S REPUBLIC

This note appears as the result of work on bark beetles collected by V.P. Grechkin during forest pathology work of the Selenga Forest Complex Expedition of the MPR in 1956 in the northern part of the MPR, and namely in the districts of Ulan-Bator, Bulgan and Upper Selenga, also in Khenteya. Collections made in the Mongolian People's Republic produced especially interesting material, including a new genus and species Gretchkinia mongolica Sokan. (Sokanvskii, 1959). I express may gratitude to V.P. Grechkin for the loan of material to work over.

1. Scolytus schevyrevi Sen. var. sinensis Egg. Ulan-Bator, July 15; Bulgan, July 28; on elm. Common. Infests elm along with S. butovitschi Stark and S. japonicus Chap.

2. Scolytus ratzeburgi Jans. Vicinity of Ulan-Bator (Shadivlyan Natural Boundary), July 3. Discovered among typical S. ratzeburgi Jans. Collected from the same place and from the same trees, were also specimens of Scolytus amurensis Egg. and S. sibiricus Egg. The last, in our opinion, should be considered a variation of S. ratzeburgi Jans., as the protuberance on the third abdominal segment is completely absent, and the broad edge of the fourth abdominal segment protrudes backward. We consider S. amurensis Egg. a synonym of S. ratzeburgi Jans., as the variations in form and size of the protuberance on the third abdominal segment are very inconstant and upon the whole not reliable. Thus, this fine series, collected in the same place and from the same trees, broadens our doubts on the synonomy of S. ratzeburgi Jans.

3. Scolytus butovitschi Stark. Ulan-Bator, July 15; Bulgan, July 28; on elm. Up to the present this species was known only from Primorsk. A large series (more than 50 specimens) permits the completion of the description of the female, which, like the male, has a small protuberance on the second abdominal segment, often not very noticeable.

4. Scolytus rugulosus Ratz. Ulan-Bator, October 3, on almond. Not typical; according to the sculpture of the pronotum and elytra it is close to S. mediterraneus Egg.

5. Scolytus japonicus Chap. Ulan-Bator, July 15, on elm. A large series (74 specimens) was compared with specimens obtained from Niisima in Japan. The species is extremely reduced in the ratio of the body length and breadth, as well as in the sculpture of the pronotum and elytra. For the territories of the USSR it was known only from Primorsk. It should be compared with S. mandli Egg., which is extremely close to S. japonicus Chap. and might possibly be synonymous with it.

6. Dendroctonus micans Kug. Vicinity of Ulan-Bator (Shadivlyan Natural Boundary), July 5, on spruce (V.I. Nosarev).

7. Polygraphus subopacus Th. Ulan-Bator (Choibalsan National Forest), October 12, on spruce. Galleries of Xylechinus sp. were also discovered here.

8. Carphoborus cholodkovskyi Spess. At the same place, June 30, on pine.

9. C. teplouchovi Spess. At the same place, 2 specimens (V.I .Nosarev).

10. Trypophloeus alni Lind. var. deevi Stark. Ulan-Bator, July 8, on willow. In a large series a significant variation is noted in this form (sculpture of the frons and elytra, length and width ratio of the body).

11. T. granulatus Ratz. Vicinity of Ulan-Bator (Shadivlyan Natural Boundary), on aspen. The finding of this large series raises the question of the possibility of finding this species in the eastern Urals.

12. Lymantor aceris Lind. Bulgan, September 1, on cotoneaster (Cotoneaster sp.) in quantities. Apparently this species is more numerous than was supposed, as it ranges throughout Siberia to Primorsk.

13. Pityophthorus lichtensteini Ratz. Vicinity of Ulan-Bator, June 28, on young cedar infected with Peridermium pini; Choibalsan National Forest, May 30, on pine. The discovery of this species in the Far East in Yakutsk, in the coastal regions of China—Futsing Province (Eggers, 1941), also in Yungning (our collection), evokes the necessity of comparing this species with P. lapponicus Stark and P. abietis Kur.

14. Trypodendron lineatum Ol. Bulgan, July 9; Ulan-Bator, June 28; Shadivlyan Natural Boundary, July 7; on pine and larch.

15. Pityogones irkutensis Egg. Selenga-Buren, October 15, on pine.

16. Pityogenes saalasi Egg. var. niger, var. n. Ulan-Bator, October 3; Choibalsan National Forest, October 12, on spruce.

17. Pityogenus baicalicus Egg. Vicinity of Ulan-Bator; Shadivlyan Natural Boundary, July 3, at an elevation of 2000 meters above sea level, on cedar; Choibalsan National Forest, June 30.

18. Ips. acuminatus Gyll. Ulan-Bator, Selenga-Buren, October 12. Common in burns, on pine.

19. Ips sexdentatus Boern. As above.

20. Ips duplicatus Sahlb. Vicinity of Ulan-Bator, Choibalsan National Forest, October 12, on spruce.

21. Ips typographus L. As above (V.I. Nosarev).

22. Ips subelongatus Motsch. Ulan-Bator, June 28; Shadivlyan Natural Boundary, July 7; Bulgan, July 9, and Khenteya. Common; centers of mass breeding occur in larch plantations.

23. Orthotomicus suturalis Gyll. Ulan-Bator, June 28, on larch and cedar.

In 1957 V.P. Grechkin found in the above localities, in addition to the species listed, Hylastes ater Payk., Polygraphus polygraphus L., Phthorophloeus spinulosus Rey., Pityophthorus tragardhi Spess., Pityogenes bidentatus Hrbst., P. chalcographus L., Dryocoetes baicalicus Rtt. var. ursus Sokan., Trypodendron suturale Egg.

SUMMARY

New data on the taxonomy and geographical distribution of bark-beetles in the USSR and the Mongolian People's Republic as well as amended old ones are given in the paper.

LITERATURE CITED

P.Z. Vinogradov-Nikitin and F.A. Zaitsev, "Data on studies of bark beetles of the Caucasus," Izv. Tiflissk. Gos. Politekhn. Inst., 2, 257-292 (1926).

B.V. Sokanovskii "On Dryocoetes alni Georg. and D. leonhardi Egg ," Zashch. Rast. 6, 5-6, 801-802 (1930).

B.V. Sokanovskii, "Notes on the bark-beetle fauna of the USSR (Coleoptera, Ipidae), " Byull. Mosk. Obshch. Ispyt. Prirody, Otd. Biolog. 59, 5, 13-22 (1954).

B.V. Sokanovskii, "New forms of bark beetles from Central Asia," Dokl. AN Tadzh. SSR 17, 43-44 (1956).

B.V. Sokanovskii, "On studies of palearctic bark-beetle fauna (Coleoptera, Ipidae)," Časop. Česk. Spol. Entom. 56, 3, 276-278 (1959).

V.N. Stark, Bark-beetle Fauna of the USSR, Coleoptera [in Russian] (Izd. AN SSSR, Moscow-Leningrad, 1952) Vol. XXXI, 1-461.

V.V. Butovitsch, 1929. Studien über die Morphologie and Systematik der palaärktischen Splintkäfer. Stett. etom. Zg., 90, 1-72.

H. Eggers, "Beiträge zur Kenntnis der Borkenkäfer, III," Entom. Blätt., 8, 113-117 (1912).

H. Eggers, "Bemerkungen zu Reitters Borkenkäferbestimmungstabellen. 2. Aufl. Entom. Blätt. 10, 297-299 (1914).

H. Eggers, "Zur palaärktischen Borkenkäferfauna, VI," Stett. Entom. Ztg. 102, 119-124 (1941).

E. Reitter, "Bestimmungstabelle der Borkenkäfer," Verh. naturf. Ver. Brunn. 33, 36-97 (1894).

E. Reitter, "Bestimmungstabelle der Borkenkäfer. 2," Aufl. Wiener Entom. Ztg. 32, 1-116 (1913).

NEW AND LITTLE-KNOWN ASIATIC PSYCHIDAE (LEPIDOPTERA)

I. V. Kozhanchikov

Translated from Entomologicheskoe Obozrenie, Vol. 39, No. 3, pp. 679-689, July-September, 1960

During the time that has elapsed since the monograph Psychidae was prepared for publication in the series "Fauna of the USSR", I have received collections of these lepidopterans from various people. These collections were not very large, but nevertheless they contained some interesting finds and some species new to science. A few very interesting psychids were obtained by D.N. Florov from the Baikal area; in 1956, near Ulan-Ude in Transbaikalia, V.D. Kolmakova collected some interesting Solenobia, Eosolenobia and Fumea; P.I. Marikovskii provided one specimen of a new species of Rebelia from the Chu-Ili hills in southern Kazakhstan; E.S. Milyanovskii obtained a few specimens of an interesting species of Fumea from the Caucasus; near Kulyab G.M. Levchenko collected a large number of cases containing live caterpillars and bred out several moths of a new species of Psychidae, for which a new genus had to be erected; A.K. Zagulyaev provided four specimens of another new species of Psychidae, which belonged to none of the previously known genera of this family. These specimens were bred out from caterpillars collected in Yunnan. This material forms the subject of the present work. The author expresses his sincere thanks to all the persons mentioned.

Melapsyche multivenosa Kozh. One female of this species was captured by O. Hesse on June 30, 1913 near L. Baikal, on the south shore. I became acquainted with it from D.N. Florov's collection. This specimen was identical with the single previously known male from Priamur'e (B. Never), from which the genus and species were described. The wing span of the female was 18 mm, the antennae were stout, not pectinate, but covered with long cilia. The female was better preserved than the holotype, and it was found that the fore tibiae in this species, as was presumed in the description (Kozhanchikov [1956]), had a long epiphysis, only a little shorter than the fore tibia.

Fumea casta Pall. Caterpillars of this species were collected on apple trees in the neighborhood of Barnaul by P.N. Davydov. Imagos were not bred out, but one case was obtained with an indication of the locality and the food plant of the caterpillar. From the structure of the case this species had to be assigned to the widely distributed European species. D.N. Florov obtained a male of this species, collected by O. Hesse on the south shore of L. Baikal on July 17, 1916. I studied the copulatory organs of this specimen; their structure hardly differed at all from that of European specimens. In 1957 in Dzungarian Ala-Tau V.I. Kuznetsov caught two specimens of this species in coitu. These finds considerably extend the range of F. casta Pall. to the east, where this species is apparently much rarer and more local than in Europe.

Fumea betulina Z. V.D. Kolmakova found a case of a caterpillar of this species on a birch tree on June 7, 1956 near Ulan-Ude in Transbaikalia. The structure of the case corresponds precisely with that recorded for the European specimens of F. betulina L. This find is interesting because it confirms Heylaerts' claim [1881] that this species occurs on the Amur, a claim which could not be verified earlier (Kozhanchikov [1956]).

Fumea elongatella Kozh. Three specimens were collected by E.S. Milyanovskii near Sochi in the western Caucasus, one on June 15, 1942 and two in 1944—May 23 and June 9. All the three males were of the same type, and were of a yellowish grey color. They were in a much better state of preservation than those from which the description was made. It was clear that although the wings in this species were narrower than those of other species of Fumea known to me, the wings in the specimens (Terek) seemed narrower since they lacked a fringe. In basic features the structure of the genitalia agreed with that found in specimens from Terek. There was the distinct right-angled excision on a distal projection of the tegumen, this projection being directed obliquely downward and separated by a fold from the basal part of the tegumen, and clearly visible in profile; the ventral process of the valvae was thick and short, with three short denticles at the distal end; the valvae were swollen at the base and strongly bent in the middle, although a little less so than in the type specimen; the form of the penis was also similar, but on a new preparation it was seen that its distal end was obliquely truncate and appeared blunt only on account of the massive pars inflabilis; the saccus was precisely the same in specimens from Sochi and Terek. These structural features of the genitalia in F. elongatella Kozh. require stressing, since in the badly preserved specimen they were not sufficiently clear.

Eosolenobia suifunella Chr. Two well-preserved males, a female on a case and five empty cases of this species were collected by V.D. Kolmakova on June 25, 1956 in a mixed wood near Ulan-Ude in Transbaikalia. This species was previously known only from the holotype (Kozhanchikov [1956]) from South Primor'e. It was now possible to study E. suifunella Chr. in more detail. The wing markings on the males have already been recorded (Kozhanchikov [1956]) and the same ratio of the eyes to the width of the frons was also retained in the two males from Transbaikalia. The structure of the case was also of exactly the same type in all the specimens collected (six cases) and agreed precisely with that described for the specimen from south Primor'e. The cases were very easily distinguished from those of E. grisea Fil. by their proportions – they were the same width but much shorter.

The male genitalia (Fig.1) were reminiscent of the genitalia of E. grisea Fil. but they showed very considerable differences in all the structures (Fig. 1). The tegumen was rather smaller and very pointed when seen in profile; its inner surface had an alveolar sculpture; the ventral half of the ninth segment and saccus were longer; the penis was of the same type as in E. grisea Fil. but was proportionally longer, with the fultura inferior bent into a loop; the valvae were more bulky in the basal half than in E. grisea Fil., but in the distal membranous half they were narrow, almost cylindrical; the ventral processes on the valvae were almost straight, being bent only at the distal end. The differences between E. suifunella Chr. and E. grisea Fil. in the male copulatory organs were much greater than was to be expected from the similarity of their coloration and wing markings.

The single female known to me from Transbaikalia has a pale brown cuticle, shiny and bare on the dorsum of the body, particularly on the thoracic segments; on the venter there are short, sparse brownish hairs; the hairs on the seventh abdominal segment are pure white; the ovipositor is blunt, stout, and short; the eyes are well-developed and black; the antennae were not completely preserved; the tarsi have four segments, and, perhaps, a fifth indistinct one. In this character the female E. suifunella Chr. differs from E. grisea Fil., since the tarsi in the latter are clearly five-segmented. The length of the dried individual is about 6 mm.

E. suifunella Chr. is evidently a more specialized species than E. grisea Fil. This is clear from the structure of the female legs and the structure of the male genitalia. In Transbaikalia this species is found in the forest-steppe, whereas E.grisea Fil. is a purely taiga species, associated with mountain taiga.

Solenobia cembrella L. A male and a case of this species were collected by V.D. Kolmakova on June 7, 1956 on trunks of birches in a mixed wood near Ulan-Ude in Transbaikalia. The specimen was quite typical and agreed both with the European specimens and with those known to me from south Primor'e. The structure of the case was also perfectly typical.

Melasina kuldzhensis Car. One female was obtained by V.I. Kuznetsov from the Dzungarian Ala - Tau (Chatyrbai, Sarkand District). The caterpillars were found on herbaceous plants and Spiraea in early May (May 4, 1957); one of them pupated shortly after, but the moth, a female, did not emerge till September 24, 1957 and was rather tattered. The female of this species was quite unknown prior to this. The specimen at my disposal was of a blackish grey color, but it did not have the patches of pale scales typical for males of this species; the wing cuticle was grey; the head, thorax and legs had a black cuticle, sparsely invested with grey hairs; the abdomen was pale, blackish grey, rather densely covered with brown scales and hairs; the seventh abdominal segment bore dense, silky, long white hairs; the ovipositor was stout, rather soft, pale yellow; the antennae were slender, filiform, and furnished with cilia. The female was slightly smaller than the male; the wing length was 7 mm, and the wing span about 16 mm. The case was similar to that known for western species of the genus Melasina; it was covered with fine sand grains.

Bijugis subgrisea Kozh. One male of this species was caught by D.N. Florov on June 15, 1936 near Irkutsk, in Gryaznukha on L. Baikal. This specimen was a little smaller than the holotype and was somewhat greyer in color. In all other characters it agreed with the single previously recorded specimen from south Primor'e.

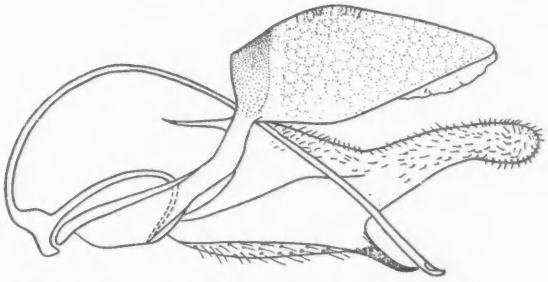


Fig. 1. Genitalia of male Eosolenobia suifunella Chr. (Ulan-Ude, Transbaikalia).

Rebelia nigricostella Kozhantshikov, sp. nov.

General coloration yellowish grey; cuticle on dorsum of head, thorax and abdomen deep black, shining, easily seen trhough the hairy vestiture; the cuticle investing venter of body head, paler than on dorsum; hairs covering the head blackish grey, sparse, erect, forming small bunches (pseudopalpi) on venter of head; hairs on body blackish grey; eyes deep black, oval, with long axis vertical, and with large convex facets; antennae less than half as long as forewing, black, covered with pale grey scales, their segments slender, rather long, and bearing paired, slender, short, widely spaced branches covered with cilia; branches gradually increasing in size from basal segments to apex; last four segments with very short branches, the first 14 with long ones; thorax and abdomen not densely pilose; integument shining through investing hair; legs densely covered with silky grey hairs, paler on underside of the legs; tarsi with same hair covering; claws simple, slender, very small; epiphysis on fore tibiae long, reaching end of tibiae and occupying three-quarters of their length; spurs well-developed, first pair of spurs on hind tibiae a little longer than second pair. Wings invested with silky yellowish-grey hairs, not transparent dull grey in color; veins convex, but covered with hairs; forewings with straight costal margin, with strongly rounded apex, oblique termen and weak tornus; costal margin bearing a broad strip of black, brown and dark grey hairs, quite distinct from other parts of wing; other parts of forewings unicolorous; their color gradually blending into the yellowish fringe; hindwings unicolorous a little greyer than forewings and not bordered on costal margin. Tegumen not long, but broad, with the distal end turned obliquely ventrad (Fig.2); the latter with two lobes divided by a deep excision; two short teeth lying one above the other on the distal end of each lobe; saccus very large and bulky; valvae almost straight, broad in basal part; their dorsal half membranous; distal end bolster-shaped, with very fine spinules; ventral half of valvae shorter, grooved, with short, weakly toothed process; penis large, distintinctly arcuate.

Holotype: male from Chu-Ilis hills, taken on April 26, 1955 by P.I. Marikovskii.

Psychidopsis alpheraki Heyl. One male of this species was captured at a light by V.I. Kuznetsov in the Trans-Ili Ala-Tau at a height of 2500 m on June 25, 1957 at the source of the R. Almaatinka in the zone of subalpine meadows. This specimen was a little larger than that from Kul'dzha and had a wing span of 16 mm and was almost pure grey in color. Possibly the yellowish hue develops later, since the specimens from Kul'dzha have been preserved for more than half a century. Otherwise, particularly in the structure of the genitalia, as far as can be judged from the strongly projecting gonapophyses in the specimen from Kul'dzha, these two specimens were identical. It was possible to study the structure of the male copulatory organs of this species (Fig. 3) in more detail. Their differences from those of P. flavescens Heyl. are considerable. The tegumen is more bulky, but is also divided at the distal end; the valvae are narrow with a stout, membranous distal portion; the lobes of the vallum penis are massive; the penis is bent in the middle.

Oiketicoides iliensis Wrli. A caterpillar of this species was found by V.I. Kuznetsov in the Dzungarian Ala-Tau (Verkhnava Talovka, Sarkand District) on Spiraea on May 4, 1957; pupation was observed on June 4, and on June 14 a damaged male emerged. It was quite recognizable and resembled the existing specimens of this species.

The larval case was cylindrical, saclike, 20 mm long, 4 mm in diameter, increasing to 5 mm below, with a very short silken tube at the apex; the surface of the case was covered with fragments of grass leaves, which were laid obliquely along the case; this arrangement of the fragments was very distinct at the top, whereas at the bottom they lay almost in line with the case.

Acanthopsyche atra L. I became familiar with a few specimens of this genus from D.N. Florov's collection. Two were taken by Mamaev on May 8 and 14, 1915 near Irkutsk and one by O. Hesse on May 24, 1916 on the shore of L. Baikal. These records reveal that A. atra

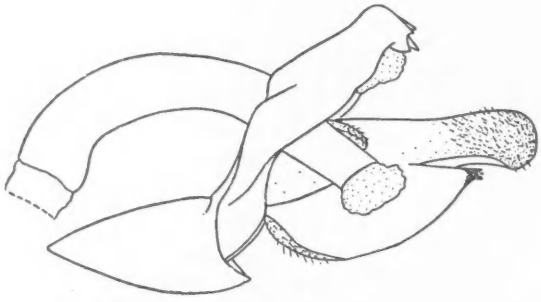


Fig. 2. Genitalia of male Rebelia nigricostella, sp. nov. (Chu-Ili hills).

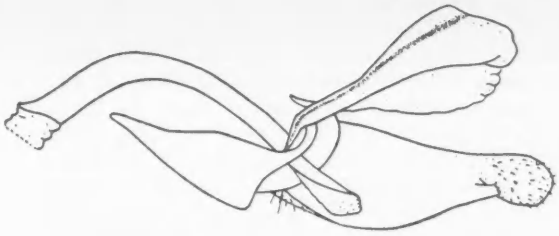


Fig. 3. Genitalia of male Psychidopsis alpherakii Heyl. (Transili Ala-Tau).

L. is widely distributed in Siberia, at least in the hills, although in Europe it occurs only in the north and in the high mountains.

Lepidopsyche unicolor Hufn. One specimen in D.N. Florov's collection was caught near L. Baikal by O. Hesse on July 14, 1916. This record now leaves only a relatively small region of Transbaikalia and the upper Amur where this species has not yet been found.

ASPINA KOZHANTSHIKOV, GEN. NOV.

Type of genus – Aspina luteiventris Kozhantshikov, sp. n.

Of average size, wing span about 20 mm. Wings large, particularly forewings, body slender, pilose but not shaggy. Head wide and short, densely pilose. Eyes small, slightly oval, with the long diameter vertical; frons wide, weakly convex, its width more than twice greatest diameter of eye; antennae much shorter than half forewing, strongly pectinate; the branches long and slender. Thorax small; fore and mid legs much longer than hind legs. Fore tibiae without epiphyses, mid and hind tibiae without spurs; tarsi five-segmented, bearing simple sharp claws with a narrow base. Forewings almost twice as long as hindwings, with strongly produced but rounded apex; hindwings spatulate. Forewing venation (Fig.4) with characteristic large spatulate discoidal cell divided by the unbranched stout media; subcosta short; all five branches of radius present, the third and fourth on a long stalk; media with only two branches, both on a short stalk; cubital veins normal; first anal vein underdeveloped in basal part, merging in distal half with second anal vein; third anal vein free only in distal half and merged in basal two-thirds with second anal vein. Hindwing venation normal; radius terminating in apical angle; branches of media the same as in forewing; all three anal veins free. Abdomen of same width as thorax, densely pilose but not shaggy. Tegumen simple, without lateral lobes; saccus wide, with short but stout ensiform process; valvae grooved, without pilose tubercle in basal half; penis distally with spinelike projections on wall; eighth abdominal sternite with short apophyses.

The chaetotaxy of the fully grown caterpillar could be studied on cast skins removed from the cases; the head capsule could not be found; the state of preservation of the skins was not good but it was sufficient for me to determine the special features of the chaetotaxy of this species (Fig.5). On the prothorax "gamma" is level with "delta", "rho" is halfway between "gamma" and "epsilon", and located caudad of them; "theta" and "eta" are on the same vertical line and "kappa" is directly in front of "eta" so that these three setae form a right angle. The prothoracic spiracles are small, oval; the setae of group "pi", two in number, are very close together and lie in the fore part of the sclerite. On the meso- and metathorax the setae "alpha", "beta", "epsilon" and "rho" are on a large sclerite, and lie in a single vertical series in its anterior half. "Alpha" and "epsilon" of these setae are considerably shorter than the other two setae; "theta", "kappa" and "eta" are on almost the same level, but "theta" is outside the sclerite; group "pi" consists of two small setae. The arrangement of the setae on the abdominal segments is normal. On the anal plate (Fig.5) there are eight setae, i.e., "epsilon" is also present as well as "alpha", "beta" and "rho".

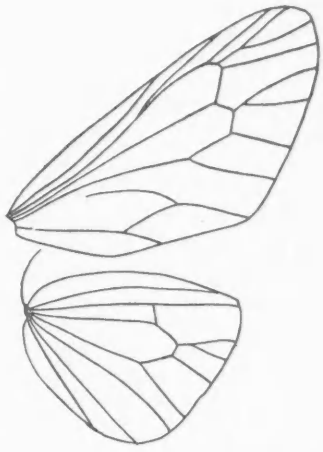


Fig. 4. Wing venation in Aspina luteiventris, sp. nov.

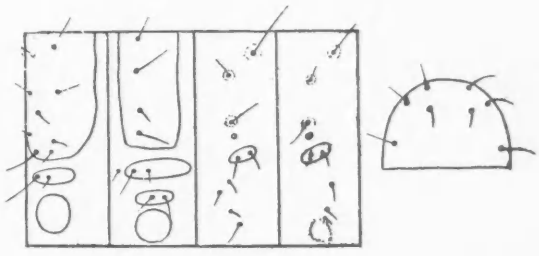


Fig. 5. Chaetotaxy of pro- and mesothorax and abdominal segments 1 and 6 of the fully grown caterpillar of Aspina luteiventris, sp. nov.

The systematic position of the genus Aspina, gen. nov., seems fairly definite, but requires substantiation. From the most obvious character—the absence of epiphyses on the fore tibiae—this genus could be related to the genus Psyche. At the same time, none of the other characters bear out this affinity of Aspina, gen. nov. In the structure of the legs and their length, apart from the lack of epiphysis, the new genus approaches Clania and Amictoides, since the hind legs are shorter than the fore legs. Important characteristics in the venation closely relate the new genus Aspina with the Acanthopsyche generic complex. The venation of Aspina, gen. nov. differs considerably from the venation of Psyche in the presence of only two medial veins on the fore- and hindwings. The system of anal veins in the forewings also differs in the rudimentary nature of the basal part of the first anal vein. The venation of the new genus Aspina is more like that of species of Acanthoecia of type A. bipars Wlk. The venation of a typical species of the genus Acanthoecia—A. larminata Heyl.—has not been described (Heylaerts [1904, 1906], Joannis [1929]) but it is probably similar to that known for A. bipars Wlk. From the species of the Acanthopsyche group—such as Oiketicoides, Acanthoecia and others—the new genus differs distinctly in the structure of the fore tibiae. At the same time, the structure of the penis and valvae most resembles that known for Oiketicoides and Acanthopsyche. In the chaetotaxy of the caterpillars the new genus Aspina also approaches the Acanthopsyche group of genera, the primary feature here being the presence of eight setae on the anal plate, i.e., the presence of the "epsilon" seta. The general nature of the chaetotaxy, in fact, most resembles that known for Pachytelia.

Thus, the new genus Aspina must be placed in the Acanthopsyche group close to Pachytelia and Oiketicoides, but remote from Lepidopsyche. The similarity of the structure of the fore legs with that of species of the genus Psyche must be regarded as a secondary character, associated with some particular processes of specialization, which have led to a reduction of the tibial spurs and the epiphysis. The new genus Aspina is the most specialized branch of the palaearctic genera of the group Acanthopsyche.

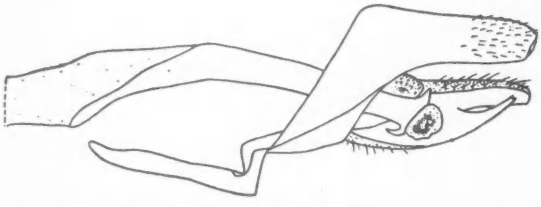


Fig. 6. Genitalia of male Aspina luteiventris, sp. nov. (S. China, Yunnan).

Aspina luteiventris Kozhantshikov, sp. nov.

General color dark brown, almost black, apart from abdominal venter, which is light yellow; basal part of wings covered with scales, opaque, their apical part almost devoid of scales, quite transparent. Head short and broad, in frontal aspect invested with light grey, black-tipped hairs; vertex with grey or whitish grey silky hairs; frons large, flat; eyes very convex, broadly rimmed, slightly oval, blackish brown; width of frons three times as long as greatest diameter of eye; antennae considerably less than half as long as forewing, blackish brown, their segments invested dorsally with white scales, and the branches with light grey cilia; greatest length of branches approximately one-fourth as long as antennae. Dorsum of thorax covered with yellowish hairs, venter with grey and blackish grey hairs, the shiny black cuticle visible through the hairy vestiture; legs black, invested with light grey hairs; claws simple, yellowish brown; abdominal dorsum anterad of ninth segment covered with dense blackish brown hairs; only the ninth segment has yellow hairs; similar hairs cover the abdominal venter, excluding the first segment, which has brown hairs as well. Forewings much longer and larger than hindwings, noticeably curved on costal margin, with very oblique termen; their basal part before dilation of discoidal cell densely covered with blackish brown scales, the zone of which expands a little towards anal margin of wing, and hence the boundary of the scales is oblique; anal margin covered with scales for two-thirds of its length; in outer hyaline part of the wing the membrane bears small hairs, which are particularly abundant along the costal margin; here they form a dark zone between the radius and costa; owing to their dark color the other veins also stand out against the transparent membrane; the fringe consists of black scales densely disposed along the wing margin; they form a black outer border; the hindwings are densely clothed with scales, blackish-brown, and have only a light zone, wider in the region of the apex and gradually narrowing towards the hind margin of the wing and along the costal margin; fringe on hindwings the same as on forewings. The underside of the wings has a covering of scales and hairs, just like the dorsal side. Wing span 19-22 mm. Tegumen broad, weakly conical (Fig.6), slightly uneven distally, rounded, weakly pilose; saccus stout and broad at base, trapeziform, tubelike proximally; the length of this part only a little shorter than expanded basal part of saccus; valvae grooved, broad and short; spiny hairs on their upper, membranous part; ventral sclerotized part with a spinulose process at distal end; lobes of vallum penis dentate above; penis massive, with two pointed outgrowths of the wall at distal end; apophyses of eighth sternite broad and short.

Holotype: male from Chingtung near Kunming, Mt. Tung-Chia-Feng, Yunnan Province, bred out from caterpillar found on July 3 in a grove of Quercus dahlbergi; imago emerged in September. Paratypes: three males

bred out from caterpillars collected in the same place and on the same date by A.K. Zagulyaev.

EOPSYCHE KOZHANTSHIKOV, GEN. NOV.

Type of genus – Eopsyche vitripennis Kozhantshikov, sp. nov.

Of average size, wing span about 20 mm; wings completely transparent; hairlike scales present only on costal margin of wings and on large veins. Body densely invested with hairs, but hairy vestiture uneven; head small, with a tuft of hairs on underside (pseudopalpi); frons rather wide, much wider than eye diameter; eyes oval, convex; antennae about half as long as forewing, strongly pectinate; branches on antennal segments long, each of them about half as long as entire antennae. Legs short; fore tibiae without epiphysis; no spurs on mid and hind tibia; hind legs shorter than others; claws on all legs simple. Wings broad and rather long; radius (Fig.7) in forewings branching late; its first branch short, close to distal end of discoidal cell; second, third and fourth branches on a common stalk; fifth branch arising by means of discal vein; media in discoidal cell well-developed, branching and forming an intrusive cell (cellula intrusa); first branch of media simple, second and third branches on long stalk; cubitus normal; first anal vein only developed in basal part, rudimentary distally; second and third anal veins normal. On hindwing subcostal vein fused with radius almost throughout its length, not separating till distal fourth of wing; media unbranched in discoidal cell; second and third branches of media on a long common stalk; other veins normal. Abdomen very long, projecting far beyond hindwings; the bare tegumen projecting at its apex. Male genitalia typified by very long penis, seven or eight times longer than valvae; tegumen with lateral, pointed lobes; saccus long, projecting with massive proximal part constituting about half its length; length of entire saccus approximately half length of penis.

Larval structures very similar to those known for species of genus Psyche. They resemble much more closely the structures of caterpillars of Psyche species than do the imaginal structure of species of these genera. The general body form of the caterpillar is spindle like; the head bears pigmented spots on the sides of the hemispheres and on the sutures. The chaetotaxy of the head is identical with that of species of the genus Psyche (Kozhanchikov [1956]). The integument of the fully grown caterpillar is pigmented only on the thorax, where there are three longitudinal stripes on each of the tergites of the pro-, meso-, and metathorax. The chaetotaxy of the thoracic segments (Fig.8) is very similar to that known for species of the genus Psyche. The only difference is that on the prothorax the seta "rho" lies on the fore margin of the sclerite, whereas in caterpillars of the genus Psyche it is displaced caudad; in view of this the setae "gamma", "rho" and "epsilon" in Psyche species are arranged at an angle, but in the new Eopsyche vitripennis, sp. nov., they lie in a straight line, on the margin of the tergite. The color of the abdominal segments of the caterpillar is milky white, their cuticle is thin and is very minutely punctate. The chaetotaxy of the abdominal segments is identical with that known for species of genus Psyche (Kozhanchikov [1956]). In particular, the arrangement of the setae of group "pi" on the segments bearing the legs is precisely the same. In Psyche species these setae are also arranged in an oblique straight line. The tergal plate of the anal segment also bears only six setae.

The systematic position of the new genus is fairly clear. It belongs to the subfamily Psychinae and is closest to Psyche. This is indicated by the absence of an epiphysis on the fore tibiae, the absence of spurs on the mid and hind tibiae, venational features and the larval chaetotaxy, and also the structure of the male genitalia. At the base of the valvae there is a pilose

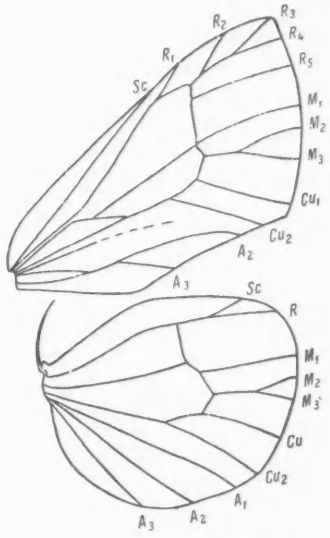


Fig. 7. Wing venation in Eopsyche vitripennis, sp. nov.

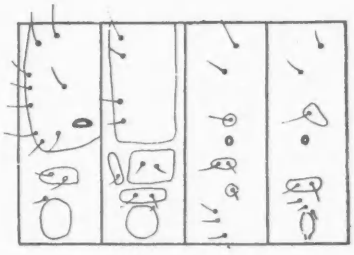


Fig. 8. Chaetotaxy of pro- and mesothorax, and abdominal segments 1 and 6 in the fully grown caterpillar of Eopsyche vitripennis, sp. nov.

tubercle, which is present on the valvae only in species of the genera Psyche and Sterrhopteryx. The lobes on the sides of the tegumen relate the new genus closely only to species of the genus Psyche. This new representative of Psychidae from Tadzhikistan is not related to extra-palaearctic genera, including species of the Indo-Malayan fauna (Hampson [1892]).

The new species—Eopsyche vitripennis, sp. nov.—reveals considerable differences in venation from that of species of Psyche, but they are all of the nature of specialization of the venation. These include the anastomoses of the branches of the radial system, of the forewing and the anastomosis of the subcosta and radius of the hindwing. The branching of the medial stalk in the discoidal cell of the forewing is very distinctive. The genital structures also reveal features of specialization as compared with those observed in species of the genus Psyche: these are the very strongly developed, long saccus and the very long penis.

All species of the genus Psyche are typical of the European—Mediterranean fauna. There are unsubstantiated records of the presence of species of this genus on the Altai. The new representative of the closely-related genus Eopsyche, gen. nov., is a derivant of the Mediterranean fauna in Central Asia. This is a phylogenetically derived genus from the Mediterranean genus Psyche, which has, of course, a long phylogenetic history. It may be surmised that this is a relict of the Tertiary Psychidae of Central Asia, which survived in the mountain conditions of Tadzhikistan.

Eopsyche vitripennis Kozhantshikov, sp. nov.

Wings transparent with yellowish veins; larger veins — costa and cubitus —covered with short, sparse, black hairlike scales; similar scales forming an area at the costal margin of the hindwing and covering the flap which engages the frenulum on the underside of the forewing; wing membrane glassy, perfectly transparent. Head invested with soft, long, but not very dense hairs, not covering the eyes; long tufts of black hairs on venter of head; eyes black; antennae with yellow segments and

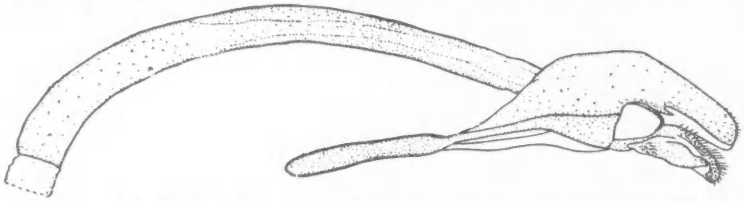


Fig. 9. Genitalia of male Eopsyche vitripennis, sp. nov. (Tadzhikistan, Kulyab).

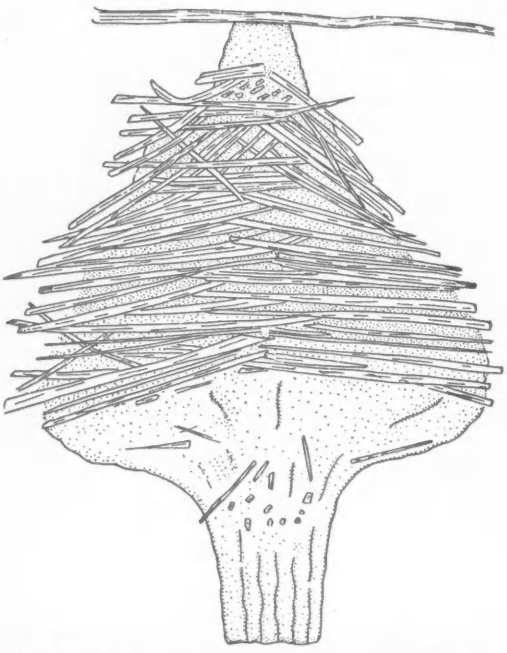


Fig. 10. Case of fully grown caterpillar of Eopsyche vitripennis, sp. nov.

grey branches; segments and branches covered dorsally with fine, white scales; branches long, inserted close together, ciliate; antennae plumelike. Thorax and abdomen black; thoracic cuticle, particularly on dorsum, mat, with minute puncturation; abdomen shining. Hairs on thoracic venter brown, brown hairs with white tips on sides of thorax; hairs on thoracic dorsum almost white, dark only at base; abdomen covered with blackish brown hairs, longer on dorsum; on terminal abdominal segment a dorsal area covered with short silky hairs. Legs almost bare, black, with shining cuticle; tarsi light brown. Wing span about 20 mm.

The male genitalia (Fig.9) are characterized by the simple structures of the long bent penis; saccus about half as long as penis, and consisting of two massive lateral extensions fused proximally into a massive unpaired portion; lobes of vallum penis grooved, dentate on dorsal margin; tegumen massive, grooved with large, pointed lateral lobes; valvae small, with strongly developed spinose (covered with short spinelike setae) dorsal part and bulky, weakly dentate ventral process.

Holotype: male from Tadzhikistan; bred out from caterpillar found near Kulyab by G.M. Levchenko in September, 1956.

Paratypes: two males bred out from pupae collected by same collector in same place.

Larval case (Fig.10) woven from white silk; in

males there is a bare, white tubular portion, 10-12 mm long, at apex of case; the rest of the surface of the case, 20-25 mm long is covered with plant fragments consisting of slender grass stems 10-15 mm long; they are laid across the case in vertical rows, so that they criss-cross all over; the rows are not tightly packed, and not even equal in length; this part of the case looks like a brush. The fully grown caterpillars cover the top of the case with a loose layer of white silky threads. The greatest diameter of the case is 20-25 mm, and its total length 30-40 mm.

The design of the case is similar to that found in species of the genera Psyche and Sterrhopteryx. The case of Eopsyche occupies an intermediate position. In general appearance, it recalls that of some of the large Sterrhopteryx. The covering of the case with silk relates it with the type of structure found in Psyche species.

Caterpillars of this new species were collected by G.M. Levchenko 40 km east of Kulyab, Muminabad District, Tadzhikistan. They were found in almost every case on camel's thorn (Alhagi camelorum Fisch.) growing on loam soils on the southern slopes of the hills. Only a few specimens were found on thick stemmed compositae growing alongside. Three male moths were bred out from pupae during the trip, but were not noted in time and were considerably damaged. Only one male retained all four wings, but their ends were broken off. Fortunately, one cast skin was preserved, and from this it was possible to study the branching of the media, which agreed completely with the remains of this vein on the wings of the imagos.

LITERATURE CITED

1. I. Kozhanchikov, Bagworm Moth (Fam. Psychidae). Fauna of the USSR. Lepidoptera [in Russian] (1956) 3, Pt. 2, 1-516.
2. G. Hampson, "Psychidae," Fauna Brit. India, Moths 1, 289-304 (1892).
3. F. Heylaerts, "Essai d'une monographie des Psychides de la faune Européenne," Ann. Soc. Entom. Belg. 25, 29-73. (1851).
4. F. Heylaerts, "Nouvelle espèce de Psychides, Chalia laminati, "Ann. Soc. Entom. Belg. 48, 419-420 (1904).
5. F. Heylaerts, "Chalia laminati nom. nov.," Ann. Soc. Entom. Belg., 50, 101-102 (1906).
6. J. Joannis, "Lepidoptera du Tonkin, Psychidae," Ann. Soc. Entom. France, 98, 532-548 (1929).
7. J. Sonan, "Psychidae of Formosa," Trans. Nat. Hist. Soc. Formosa, Taihoku 25, 448-455 (1935).

PHIARIS CAPTIOSANA, SP. N., – A VICARIATE OF PHIARIS ARCUELLA CL. IN THE EASTERN REGIONS OF THE PALAEARCTIC (LEPIDOPTERA, TORTRICIDAE)

M.I. Fal'kovich

Translated from Éntomologicheskoe Obozrenie, Vol. 39, No. 3, pp. 690-692, July-September, 1960

Hitherto it was thought that one of the commonest tortricids – Phiaris arcuella Cl. – was widely distributed in the Palaerctic and that its range extended to the eastern limits of this region (Issiki [1957]). However, Walsingham [1900] had already pointed out that specimens of this species from Korea and Japan differed appreciably from European specimens of Ph. arcuella.

My investigation of the morphological characters of moths regarded as the eastern form of Ph. arcuella has shown that this form is characterized by a whole series of distinct differences and is undoubtedly an independent species, the description of which is given below.

Phiaris captiosana Falkovitsh, sp. n.

Adult moth. In color and wing markings very similar to Phiaris arcuella Cl.

Wing span 14-20 mm, usually about 18 mm. Forewings weakly expanding towards apical margin; their fore margin slightly curved, outer margin oblique apex blunt.

Color of forewings browish orange; the markings consist of the same components as in Ph. arcuella: leaden silver lines and a light (yellowish white) area around an oblong black spot lying in the outer marginal half of the wing. However, the four streaks passing into the light area are a little thinner, and portions of the ground color around the black spot are absent, so that on the whole the light area is larger, stands out more clearly, and is more sharply outlined (in Ph. arcuella only the light portion adjacent ot the black spot on the side of the costal margin stands out clearly). Part of the light area lying between the black spot and the hind margin of the wing extends along the entire spot in Ph. captiosana, so that the margin of the light area facing the root of the wing is generally straight and almost parallel to the leaden silver line demarcating the basal third of the wing. Within the black spot there are three leaden silver dots; in addition to these three inner dots Ph. arcuella has a fourth, located between the hind margin of the wing and the black spot (closer to the end of the latter facing the root of the wing). The light area in Ph. arcuella extends only to this outer leaden silver dot, i.e., in contrast to Ph. captiosana, it does not extend towards the root of the wing as far as the inner end of the oblong black spot. The fringe in both species is the same, dark grey with a sheen.

The hindwings are brownish grey, paler at the root and darkening towards the apex and margin (in Ph. arcuella the hindwings are darker and uniformly colored). The taglike projection of the hind margin of the wing in the males is straight, and very strongly produced, as long as the fringe (in Ph. arcuella it scarcely projects at all). The fringe is greyish white.

The palps are greyish yellow with darkened apices; the head in dorsal aspect is brownish grey, the frons greyish yellow. The dorsum is brownish orange with an admixture of brownish grey scales. The abdomen is brownish grey.

The main differences between this species and Ph. arcuella are: Ph. captiosana, sp. n. specimens are larger on the average, the main coloration of the forewings is paler, there is no leaden-silver dot between the black spot and the hind margin of the wing. The area occupied by the light patch is relatively larger, and the taglike appendage of the hind margin of the hindwing is much longer.

Copulatory armature of male (Fig.1). Uncus a little broader than in Ph. arcuella, so that there are no distint "shoulders" to the tegumen. Penis sclerotized on left and a little below, three groups of spines on pars inflabilis: the central group consists of several spines and the two lateral groups usually each consist of a pair of spines (Ph. arcuella has two groups of spines, the first consisting of four to five smaller ones, and the second of three to four larger spines). The structure of the valvae in general is the same as in Ph. arcuella but the bunch of strout setae in the basal part of the valva is thinner, the distance from it to the edge of the basal pit being less than the diameter of the bunch itself (in Ph. arcuella this distance is more than the diameter of the bunch).

The spines constituting the oblique series which separates the basal part of the valva from the apical part are subequal in size (in Ph. arcuella they decrease in size towards the upper margin of the valva). The projection of the lower margin of the valva is usually broader than in Ph. arcuella.

Fig. 1. Phiaris captiosana, sp. n., ♂, copulatory armature.

Fig. 2. Phiaris captiosana, sp. n., ♀, copulatory armature.

Copulatory armature of female (Fig.2). Papillae anales similar to those in Ph. arcuella. Ostium bursae relatively broad, round, surrounded by a ring lying close to the ductus bursae, the ring being strongly sclerotized on the anterior margin and on the sides. A broad process, curving up towards the dorsal side, extends from the hind part of the structures surrounding the ostium; the lateral margins of this process are heavily sclerotized and diverge a little.

Thus, the structure of the copulatory armature of the female of Ph. captiosana differs markedly from that in Ph. arcuella (in the latter species the margins of the ostium are capitately swollen) and in some general features has more in common with the structure of the genitalia in female Ph. subtilana Flkv.

All the specimens of Ph. captiosana, sp. n. listed below and used for the new description are preserved in the collection of the Zoological Institute of the Academy of Sciences, USSR.

Holotype - ♂, Simonovo, Amur Reg. 75 km west of Svobodnyi [13/VI/1959 (Fal'kovich).

Allotype - ♀, in the same, place, 5/VII/1959

Paratypes - Maritime Territory. Ussuriisk 26/VI/1959 (Fal'kovich) Nikol'sk-Ussuriiskii, 1913, 1 ♀ (Andrievskii); 7/VII/1931/, 1 ♂ (Mishchenko); 27/V/1932, 1 ♀ (Tokareva). Suchan, 25/VI/1928, 5♂♂; 2/VII, 1♂; 3/VII, 1♂; 7/VII, 1 ♀ (Kurentsov). Kedrovaya Pad' Reserve, 19/VI/1926. 1 ♂ (Mordvilko). Iman District 17/VI/1934, 3♂♂ (Kurentsov). Ol'ga Bay, 14/VI/1913, 1 ♀ (Soldatov). St. Vyazemskaya, 30/VI/1909, 1 ♀ (Borzov). Vinogradovka, 8/VI/1929, 1♂; 10/VI, 1♂; 11/VI, 1♂; 12 /VI, 1♂; 13/VI, 1♂; 20/VI, 1♂; 2 /VII, 2♂♂; 3/VII, 1♀; 6/VII, 1♂ (D'yakonov, Filip'ev). Amur Region. Simonovo, 19/VI/1959, 1♂; 13/VI, 4 ♂♂ (Fal'kovich). Klimoutsy, Svobodnyi District, 19 VI - 17 VII 1958, 75♂♂, 28♀♀ (Kuznetsov and Sukhareva). Irkutsk, 12/VI/1906, 1♀ (Yurinskii). Krasnoyarsk Region. Minusinsk, 16/VI/1924, 2♂♂ (Filip'ev). 28/VI/1925, 1♂; 1/VII, 1 ♀ (Kozhanchikov). 19/VI/1926, 1♂ (Gerasimov); 14/VII, 1♀ (Tsygankov). Bunbui, Kansk District, 15/VI/1916, 1♂ (Valdaev). Kemerovo Region. Vaganovo, Salair Ridge, 16/VI/1955, 2 ♀♀ (Fal'kovich).

The collection also contained three males with an incomplete label—"Korea, 11/VI, Herz" and two males with the label—"Ussuri, 25/VI, Bremer".

From an examination of a large amount of collection material it was found that all the moths collected east of Taishet and identified as Ph. arcuella belonged to the species Ph. captiosana.

Thus, Ph. arcuella occurs in the western part of the Palaearctic and Ph. captiosana in the eastern part. The ranges of these species evidently overlap only in a longitudinal strip lying between Salair Ridge and Taishet (both Ph. arcuella and Ph. captiosana have been recorded from Taishet area).

The third species of this group—Ph. subtilana Flkv., described from southern Siberia (Fal'kovich [1959]), was recently discovered by the author in Leningrad Region (Tolmachevo, Luga District, 13-15/VI/1960, 50♂♂♀♀). Obviously Ph. subtilana is the most widely distributed and its range considerably overlaps those of Ph. arcuella and Ph. captiosana.

SUMMARY

A new tortricid Phiaris captiosana is described. It is very similar to Ph. arcuella Cl, but appreciably larger (wing span up to 20 mm) and the coloring of the forewing is paler and the hindwing rather lighter.

There are also differences in the wing markings (in Ph. captiosana, as in Ph. arcuella, the forewings have a

pale yellowish white patch in the hind half, but this patch is broader; there is no silver dot under the black spot).

Ph. captiosana, sp. n. is also easily distinguished by its genitalia (Fig.1 – ♂, Fig.2 – ♀).

Distribution: Eastern Siberia (east of the spurs of the Altai), Korea, Japan. In these areas the new species replaces Ph. arcuella.

LITERATURE CITED

1. M. Fal'kovich, "New and little-known species of the genus Argyroploce (s. lat.) from South Siberia (Lepidoptera, Tortricidae)," Éntom. Obozr. 38, 2, 461 (1959).*
2. S. Issiki, "Eucosmidae", T. Esaki, S. Issiki, H. Inoue, A. Mutuura, M. Ogata, et H. Okagaki. Icones Heterocerorum japonicorum in coloribus naturalibus," 74 tab. 12. (Osaka, 1957).
3. T. Walsingham, "Asiatic tortricidae," Ann. Mag. Nat. Hist., ser 7, 6, 31, 128 (1900).

*Original Russian pagination. See C.B. Translation.

SOME BUTTERFLIES (LEPIDOPTERA, RHOPALOCERA) OF THE PALAEARCTIC FAUNA

A. E. Standel

Translated from Éntomologicheskoe Obozrenie, Vol. 39, No. 3, pp. 693-696, July-September, 1960

I. THE SUBSPECIES COLIAS AURORA ESP. FROM ALTAI

Colias aurora Esp., which we collected in considerable numbers in 1951–1952 in the districts of Chemal and Shebalino in Altai, is a subspecies which has not hitherto been described. In honor of B.S. Semenova, a specialist in the regional study of Siberia and Altai and one who gave considerable assistance to the author in his study of the lepidopterous fauna of Altai, this species is given the name of Colias aurora semenovi, subsp. nov.

The males of C. aurora semenovi, compared with those of the type form, have a darker orange ground color on the upper side of the wings and a more developed dark granulation along the veins. Individual specimens vary quite considerably. The shade of orange color varies somewhat (from redder to dull orange) and at the same time the degree of development of the dark color along the veins is variable. Many specimens are shot with a reddish rose-violet hue.

The females of C. aurora semenovi are extremely variable and interesting. Here we meet with three (not two, as in the typical subspecies) polymorphic forms of females:

1) orange females with a strongly developed infuscation of both the fore-wings and especially the hind-wings, and with dark veins; in the females of the type aurora Esp. the orange tinge is rather richer, the infuscation almost absent and there are no dark veins;

2) melanic females with the reddish- orange color (peach color) of the central portion of the fore-wings developed to various degrees; at the same time the hind-wings are always infuscated with the exception of the light spots at the edge, a central spot and sometimes a small area along the front edge;

3) melanic females in which the orange color in the previous form is replaced by orange-white.

Among forms 2 and 3 there are gradual transitions; on the whitish background of the central area in the intermediate specimens is an orange bloom of varying intensity, occupying one or two spaces between the veins. The veins of both forms 2 and 3 are darkened as in form 1.

The dimensions of both males and females are, on an average smaller than those of the type aurora from the Far East. The orange and white forms of the subspecies in question correspond with two of the well-known forms of females of the typical subspecies (C. aurora Esp. and C. aurora f. chloë Ev.). The form having the reddish-orange color is either not met with or is only very rarely found as an aberration (may be parallel with C. aurora f. crocopoepla Warnecke [Seitz, 1933]).

The distribution of C. aurora semenovi is, evidently, confined to Altai. In every instance, the specimens from Tuva in the author's collection belong, according to color, to the typical forms and scarcely differ from those originating in Transbaykalia and the Far East.

In Altai C. aurora semenovi inhabits chiefly the dry valley steppe regions and is met with in large numbers in the neighborhood of cultivated land (cereal crops). It is not found high up in the mountains or in damp wooded localities. It is usually quite local. It flies from the end of June to the beginning of July. Males and females are almost equally numerous. Among the females the orange specimens are the fewest (15%-20%); the melanic forms of females with orange and white coloring are met with in more or less equal numbers.

The relation between the subspecies described here and the forms of C. aurora (Seitz, 1909, 1933) has already been partially recorded. It is possible that f. obscura Moltrecht. is identical with the extreme melanic form of female of the subspecies semenovi. Unfortunately, we have not come across the form alpina Vrty. from Onguday in the field; judging from the description, the males of this form are lighter than those of the type. Since all the males of aurora semenovi described by us from northern Altai are not lighter, but darker than the type, one cannot be sure of the identity of either semenovi or alpina.

In conclusion, it was found that on examination of the collections from ZINa and of specimens from Moscow University, forms similar to those described here were absent. In particular, we saw no specimen of the females which we described as having a peach-orange area in the middle of the fore-wings.

II. SEASONAL DIMORPHISM IN THE BUTTERFLIES LYCAENIDAE (LYCAENA) AND NEW FORMS OF LYCAENA ARGUS SCHIFF.

The majority of the Lycaenidae in the genera Lycaena, Everes and Cyaniris have one annual generation. Only a few species of the Lycaenidae among the palaearctic fauna have two generations. Quite regularly

and more or less universally one meets with two generations in Everes argiades Pall., Lycaena aegon Schiff., L. argus Schiff., L. baton Bgstr., L. orion Pall., L. astrarche Bgstr., L. icarus Rott. (three generations in the south), L. bellargus Rott., L. iolas O., Cyaniris argiolus L. With the exception of E. argiades seasonal dimorphism has not been observed (in icarus the generations differ somewhat in size).

It is very noticeable that almost all the numerous species having two generations (except iolas and partially baton) belong to the very generally and widely distributed Lycaenidae. Evidently, this is not a fortuitous phenomenon. One might suppose that the capacity to produce a few generations annually is one of the manifestations of vital energy of the species and may be of common and wide distribution among the species flourishing at the present day. This deduction is confirmed in all groups of lepidoptera. Thus, two or more generations are met with in Papilio machaon L. and P. podalirius L., from Papilionidae; Pieris brassicae L., P. napi L., P. rapae L., Synchloë daplidice L. Colias hyale L., C. chrysotheme Esp., C. crocea Fourcr., C. myrmidone Esp., C. erate Esp., Gonepteryx rhamni L., Leptidia sinapis L., from Pieridae; the species Pyrameis, Vanessa, Melitaea phoebe Knoch., M. didyma O., M. trivia Schiff., M. cinxia L. (in the south), Brenthis selene Schiff. (in the south), B. euphrosyne L. (in the south), Argynnis latonia L., Pararge maera L., P. megera L., P. egeria L., Coenonympha pamphilus L. from Nymphalidae and Hesperia malvae L., H. alveus Hb. from Hesperiidae.

Of these numerous species almost all seem to be very generally and widely distributed representatives of their genera. In a number of instances "flourishing" forms have one generation (for example, Aporia crataegi L., Euchloë cardamines L., Argynnis aglaja L., A. adippe L., A. paphia L.), but the reverse situation is rarely met with; only a comparatively small number of local species, few in numbers of individuals, are known which would produce more than one annual generation.

Systematic relationships in the group of Lycaenidae. Lycaena argus Schiff.—L. aegon Schiff , are very involved. Both the specific independence of a number of forms (for example, L. argyrognomon Bgstr.) and the subspecies composition are not sufficiently studied in this group.

In the course of the study of the lepidopterous fauna of western Siberia and Altai the author encountered two new forms of L. argus Schiff. and at the same time made an interesting observation about seasonal dimorphism which is rarely seen in this species and, generally speaking, has not been observed in the genus Lycaena.

The two new subspecies are named Lycaena argus korshunovi, subsp. nov., in the possession of Yu.P. Korhsunova, the lepidopterist who is my pupil, and Lycaena argus katunica, subsp. nov. (from the river Katun).

The occurrence of these subspecies is as follows: —L. argus korshunovi is found in the Novosibirsk region and the Salairo-Kuznitsk district, L. argus katunica from Altai. Seasonal dimorphism is found in both species and the individuals of the second generation in both species differ little from those of the European argus; the first generation differ among themselves and from the European forms of the species and, in general, are different from all the forms described in the literature.

In the collections of the Zoological Institute AN SSSR and of Moscow University the author found no specimens like those of the first generation of L. argus korshunovi and L. argus katunica.

The description of the two new species are given below.

1) Lycaena argus korshunovi subsp. nov.

The males and females of the first generation are usually decidedly larger than the European forms. In the males the upper side is bluer than in the European subspecies and the violet shade is much less developed. The black outer edge is considerably wider (almost as in L. aegon) and the black veins are clearly marked. On the lower side, in the majority of specimens, a white tint is quite evident between the row of ocelli and the orange spots (both in the males and the females). It flies from June 5th—10th.

The second generation is smaller and has weakly developed black veins and a much narrower outer edge. It is reminiscent of the European argus. The violet shade on the upper side of the male is more noticeable than in the type form (a transition to the subspecies planorum Alph.). It flies in August.

2) Lycaena argus katunica subsp. nov.

The first generation differs still more markedly from the European type form. The dimensions are the same as in argus korshunovi. The upper side of the male is still bluer and of a rich color, with an unusual silvery hue but almost no violet. The outer edge is almost as wide as in korshunovi but the black granulation along the veins is not very marked. The lower side, both in male and females, is very light and has a sharply defined white field between the ocelli and the orange spots. It flies from June 25th.

The second generation is smaller and has the dark outer edge narrower and the dark veins weakly marked. In the males the upper side is darker than in the European form and the violet hue is much stronger (almost as in the subspecies planorum Alph.). The lower side is not as light as in the first generation but in may specimens it is the same as in the European form. It flies at the end of July and in August.

At the present time it is premature to talk about all the forms of L. argus Schiff. within the boundaries of SSSR. We observed considerable seasonal dimorphism which complicates the problem and makes it necessary to examine the data on the Asiatic forms of the species. Roughly, it is possible to presume that the following forms (subspecies) of L. argus are present in SSSR with the given characters and distribution:

1) The typical form of L. argus Schiff.—from the European parts of SSSR, the Crimea, Caucasia (?).

2) Lycaena argus korshunovi, subsp. nov., the less violet form with a wide outer edge to the wing and with black veins (first generation).—from western Siberia (western limits not clear), may be central Siberia as far as Eniseya.

3) Lycaena argus katunica, subsp. nov. A still richer blue form (first gereration) with a wide outer edge to the wing and without dark veins.—from Altai.

4) Lycaena argus subsolanus Ev. A very large dark form with a strong violet tinge in the males.—from eastern Siberia, Transbaykalia, Seasonal dimorphism?

5) Lycaena argus planorum Alph. A richly colored form with a reddish-violet hue and narrow outer edge to the wing.—from central Asia. Seasonal dimorphism?

The form dschagatai Gr.-Gr., described by Grum-Grzhimail from Altai, is closely related to planorum Alph. (Seitz, 1909) and, probably, represents the second generation of katunica. The forms gannsuensis Gr.-Gr. and sifanica Gr.-Gr. may be related to katunica and appear to be the first generation of the central Asiatic subspecies.

LITERATURE CITED

1. A. Seitz, Die Gross-Schmetterlinge der Erde. Die palaearktischen Tagfalter (Stuttgart, 1909).
2. A. Seitz, Die Gross-Schmetterlinge der Erde. Die palaearktischen Tagfalter. Supplement (Stuttgart, 1933).

A PALAEARCTIC SPECIES OF THE GENUS COELOPENCYRTUS TIMB (HYMENOPTERA, ENCYRTIDAE)

V. A. Tryapitsyn

Zoological Institute, Academy of Sciences, USSR, Leningrad
Translated from Entomologicheskoe Obozrenie, Vol. 39, No. 3, pp. 697-700, July-September, 1960

In early 1958 S.I. Malyshev presented to the Zoological Institute some interesting encyrtids which he had bred out in Khopersk Reserve (Voronozh Region) from the larva of a solitary bee of Hylaeus sp. (Hylaeinae). The parasite was found to be a new species of the genus Coelopencyrtus Timb., six species of which are known only from the Hawaiian Is, and two from N. America (one from Utah, the other from Maryland). Four of the Hawaiian species parasitize larvae of wasps of the genus Odynerus Latr., while C. kaalae (Ashm.) was bred out from larvae and pupae of the solitary bees Nesoprosopis fuscipennis (Smith) and N. pubescens Perk. – a genus closely related to the genus Hylaeus. It is possible that the species described below is of polyembryonic habit, since the swollen and partitioned larva from which the parasites were bred out was very reminiscent of caterpillars infested by polyembryonic species of encyrtids of the genera Ageniaspis Dahlb., Copidosoma Ratz., Litomastix Thoms. and Paralitomastix Merc. A similar type of infestation was described for the Hawaiian species (Timberlake [1919]) and the North American C. hylaei Burks (Burks [1958]). In addition, in India there was found a polyembryonic parasite Giraultella krishnamurtii (referred to by Mahdihassan [1957]), which develops in larvae of Xylocopa tenuiscapa Westw.; G. pallidiceps (Gir.) and G. xylocopae (Gir.) were bred out in Java from larvae of X. caerulea (Fabr.) Lep., X. aestuans (L.) Ill. and X. tenuiscapa Westw. (Roepke [1919]). The genus Giraultella Gah. et Fag. is probably closely related to the genus Coelopencyrtus. It should be noted that species of Odynerus, Hylaeus, Nesoprosopis and Xylocopa nest in dry wood.

The genus Coelopencyrtus Timb. is characterized by the following main characters (Burks [1958]). Mandibles with three teeth, maxillary palp with four segments, labial palp with two segments. Antennae inserted near mouth border, funicle with six segments, most or all which are broader than long. Club three-segmented, three-quarters as long as, or as long as, the entire funicle, and wider than the widest segment of the flagellum. Length of cheeks varying from three-fifths to nine-tenths length of eye. Frons and vertex broad, without alveolar punctures; lateral ocelli almost touching eye margins. Mesoscutum and scutellum shining, smooth or very minutely reticulated. Wings well-developed. Submarginal vein of forewing with no apical triangular enlargement, marginal vein as broad as long, radius equal to marginal and postmarginal combined. Marginal fringe of forewing very short and dense. Femora and tibiae flattened. Mid tibial spur as long as first mid tarsal segment. Propodeum extremely short in middle, spiracle separated from propodeal margin by a space equal to its own diameter. Ovipositor concealed or slightly exserted. Pedical and funicle segments of male antennae varying from simple to more or less ramose, club entire. Head of male with a more or less developed protuberance above the eyes.

Coelopencyrtus malyshevi Trjapitzin, sp. n.

Female. Body elongate (Fig.1). Gaster subequal to head and thorax combined (alcohol-preserved material). Mesoscutum and scutellum forming an obtuse angle, this being perhaps due to the flexibility of the articulation between them. Head in anterior aspect a little broader than long, as broad as thorax. Vertex and frons twice as long as broad, inner margins of eyes parallel. Ocelli forming an almost equilateral triangle, the distance between the lateral ocelli being slightly greater than the distance from each lateral ocellus to the anterior ocellus. Lateral ocelli separated from margin of occiput by a distance equal to their own diameter. Length of cheek about two-thirds length of eye. Antennal grooves uniting; median projection visible from above. Mouth opening very broad, equal in width to length of cheek of slightly more than it. Distance between antennal foveae subequal to distance from antennal fovea to margin of occiput. Antennae (Fig.4) clavate, scape more than three times as long as its greatest width and a little shorter than pedical and funicle together. All funicle segments transverse; first four small, almost ringlike and almost identical, each of them approximately twice as broad as long; fifth and sixth much broader than preceding ones. Club a little longer than funicle and broader than its last segment. Maxillary palps four-segmented, labial palps three-segmented (Fig.2 and 3).

Pronotum transverse, six to eight times as broad as long. Mesoscutum twice as broad as long. Axillae

narrow, with contiguous apices. Scutellum flat. Forewings a little more than twice as long as their greatest width, hyaline, rather uniformly and finely pubescent, with a short and dense marginal fringe. A bare oblique streak is differentiated, i.e., with a series of large hairs on the outer margin. Costal cell approximately ten times as long as its greatest width. Marginal cell a little longer than broad, postmarginal a little longer than marginal and shorter than radial (Fig.5).

Fore margins of gastral tergites, beginning at fourth (second visible), with a notch in center. Pygostyles halfway between base and apex of gaster. Ninth syntergite illustrated in Fig. 6. Ovipositor exserted approximately one-sixth to one-fifth length of gaster. Paratergites lacking. Seventh sternite reaching end of gaster. Outer plates of ovipositor twice as long as their greatest width.

Vertex and frons, pronotum, mesoscutum and scutellum minutely reticulated. Cheeks longitudinally striate. Body dark, with metallic luster. Vertex with golden green, frons with blue, face with blue green luster shading to bronze green at edge of mouth. Pronotum and mesoscutum dark green, scutellum golden bronze. Sides of mesothorax brown. Gaster brownish black, with golden bronze luster. Antennae, legs and ovipositor brown, apices of antennae and legs paler. Length about 1.7-1.8 mm.

Male. Head in anterior aspect as broad as long. Distance between antennal foveae greater than distance from antennal fovea to eye margin. Scape (Fig. 8) dilated; pedical a little shorter than first two funicle segments taken together. Funicle six-segmented, uniformly thickened. First funicle segment subquadrate, the remainder transverse. Club entire, not broader than funicle and equal in length to pedicel. Mandibles three-toothed (Fig.7). Phallus with very long parameres and two spines on each digital sclerite (Fig.9).

According to the generic diagnonis of Burks [1958], the species of Coelopencyrtus known to him have two--segmented labial palps, whereas in C. malyshevi they are three-segmented. The described species is apparently close to C. hylaei Burks from Maryland, and differs from it in the following characteristics:

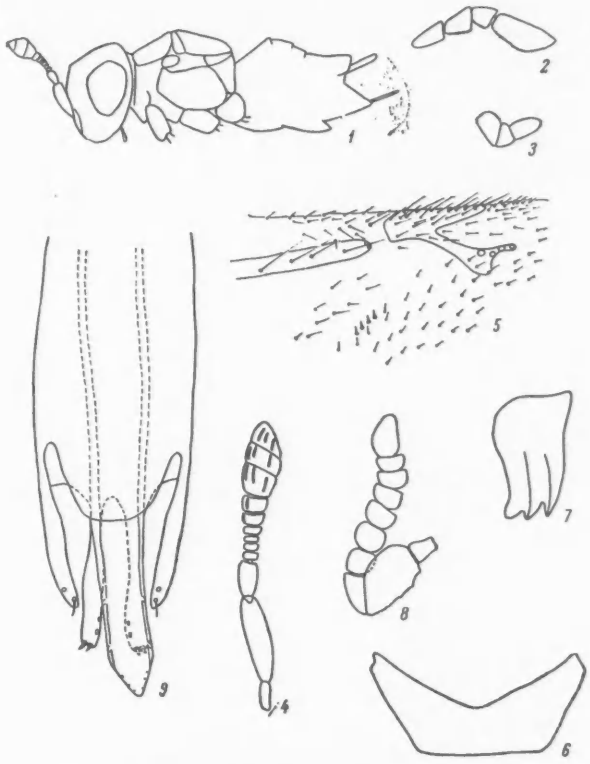


Fig.1-9. Coelopencyrtus malyshevi sp.n. 1) body ♀, from side; 2) maxillary palp ♀; 3) labial palp ♀; 4) antenna ♀; 5) forewing venation ♀; 6) ninth syntergite ♀; 7) mandible ♂; 8) antenna ♂; 9) phallus.

C. hylaei Burks

Gaster in female nine-tenths as long as thorax.
Ovipositor exserted one-quarter length of gaster.
Scutellum in female without metallic luster.
All funicle segments of male subequal in length; club as long as last two funicle segments together.

C. malyshevi sp. n.

Gaster in female as long as head and thorax together.
Ovipositor exserted one-fifth to one-sixth length of gaster.
Scutellum in female with golden bronze metallic luster.
Last two funicle segments much shorter than first and second; first funicle segment subquadrate, the last approximately twice as broad as long; club subequal to last three funicle segments together.

Material studied. Khopersk Reserve, Voronezh Reg. From larva of Hylaeus, 23/VI/1957, 29 ♀♀ and 1♂ (S. Malyshev). Holotype (♀) in form of the whole mount. Allotype (♂) also mounted, but in dismembered form. 1 ♀ on a card triangle, the rest in alcohol. Apart from the 22 typical females, from which the description was compiled, one nontypical was found. In this female the mesoscutum and scutellum lay in the same plane, and the gaster was shorter than the thorax. The articulation between the mesoscutum and the scutellum in Coelopencyrtus has apparently some flexibility, a feature observed in greater degree among chalcids of the Eupelmidae, particularly in Eupelmella Masi. Five damaged ♀♀ of C. malyshevi were removed from cells in the skin of the host larva.

The material is preserved in the collection of the Zoological Institute, Academy of Sciences, USSR (Leningrad).

The author thanks V.V. Popov and M.N. Nikol'skaya for valuable advice.

LITERATURE CITED

B. D. Burks, A recharacterization of the genus Coelopencyrtus, with descriptions of two new species (Hymenoptera, Encyrtidae) Journ. Washington Acad. Sc. 48, 1, 22-26 (1958).

S. Mahdihassan, "Giraultella krishnamurtii," Current, Sc. 26, 6, 182 (1957).

W. Roepke, "Some additional remarks concerning Mr. Girault's descriptions of new Javanese chalcidflies," Treubia 1, 2, 60 (1919).

P. H. Timberlake, "Descriptions of new genera and species of Hawaiian Entom. Soc. 4, 1, 197-231 (1919).

SPECIES OF GENUS COCCOPHAGUS WESTW. (HYMENOPTERA, CHALCIDOIDEA) FROM SZECHWAN PROVINCE, CHINA

E. S. Sugonyaev and P'êng Chung-yün

Zoological Institute, Academy of Sciences, USSR and Department of General Entomology, Leningrad Agricultural Institute

Translated from Éntomologicheskoe Obozrenie, Vol. 39, No. 3, pp. 701-707, July-September, 1960

A considerable part in the formation of the fauna of subtropical crops is often played by foreign species of insect pests introduced into new regions where their natural enemies are absent. The discovery of effective entomophages in regions within the natural ranges of these insects is one of the prerequisites for the development of biological methods of controlling them.

In the summer of 1958, at the suggestion of G.Ya. Bei-Bienko, one of the authors of this paper (P'êng Chung-yün) made a study of the entomophages preying on scale insects injurious to citrus and other subtropical crops in Szechwan Province in China – a region where citrus crops have been cultivated since ancient times, and which lies in a very ancient center of the temperate fauna and flora of Eurasia. It was expected that a rich and varied fauna of useful entomphages would be found, and this was fully confirmed by the investigations. This paper is devoted to species of the genus Coccophagus in Szechwan, of which seven are listed here; prior to this only two species were known – C. hawaiiensis Timb. and C. yoshidae Nak. Further investigations will probably lead to the discovery of several other species of this genus.

The material was worked through in the Zoological Institute and in the Department of General Entomolgy of Leningrad Agricultural Institute. The types and paratypes of the new species will be presented to the Institute of Entomology of the Chinese Academy of Sciences in Peking, and some of the paratypes will be presented to the Zoological Institute in Leningrad.

The authors are grateful to G.Ya. Bei-Bienko and M.N. Nikol'skaya for help and cooperation in the work.

KEY TO SPECIES OF GENUS COCCOPHAGUS WESTW. IN SZECHWAN PROVINCE.♀♀

1 (12) Scutellum usually with three pairs of setae.

2 (5) Pedicel usually distinctly shorter than first funicle segment, last segment longest.

3 (4) Club compact, somewhat elongate-oval, broader than last funicle segment (Fig. 1). Mid femora, mid and hind tibiae always yellow . . . . . 1. C. japonicus Comp.

4 (3) Club less compact, elongate, subequal in width to last funicle segment (Fig.6). All femora more or less darkened or blackish . . . . . 2. C.hawaiiensis Timb.

5 (2) Pedicel longer than first funicle segment; if equal to or slightly longer than first funicle segment, then the last is usually not the longest.

6 (7) Body black, only the scutellum partly yellowish. Second funicle segment subequal to or slightly longer than pedicel, subequal to second and shorter than third funicle segment. All femora and tibiae more or less brown or brownish, mid femora and tibiae pale, darkened at base . . . . . 3. Coccophagus sp.

7 (6) Body yellow or orange-yellow, with brownish spots or streaks. First funicle segment shorter or equal to pedicel.

8 (11) Body yellow or orange-yellow, darkened in places or with small brownish spots.

9 (10) Second funicle segment less than twice as long as broad, pedicel a little longer than first funicle segment . . . . . 4. C. chengtuensis Sug. et Peng, sp. n.

10 (9) Second funicle segments two and a half times as long as broad, pedicel subequal to first funicle segment. Wings normal, not narrow . . . . . 5. C. viator Sug., sp. n.

11(8) Body yellow, with longitudinal dark brown streaks on sides, the streaks extending from pronotum to apex of abdomen . . . . . 6. C.? longifasciatus How.

12(1) Scutellum with many short setae, as on mesonotum. Body, including scutellum, black; all femora black or dark brown, whitish at apices . . . . . 7. C. yoshidae Nak.

1. Coccophagus japonicus Comp. (Figs. 1-5).

Recorded from Tingtang district, in the neighborhood of Chengtu and Peipei. Most frequently occurs in damp habitats, in river flood-plains, and close to ponds.

The legs in female C. japonicus very considerably in color, from almost entirely yellow to partly brownish, but the mid femora and tibiae are always yellow. Dif-

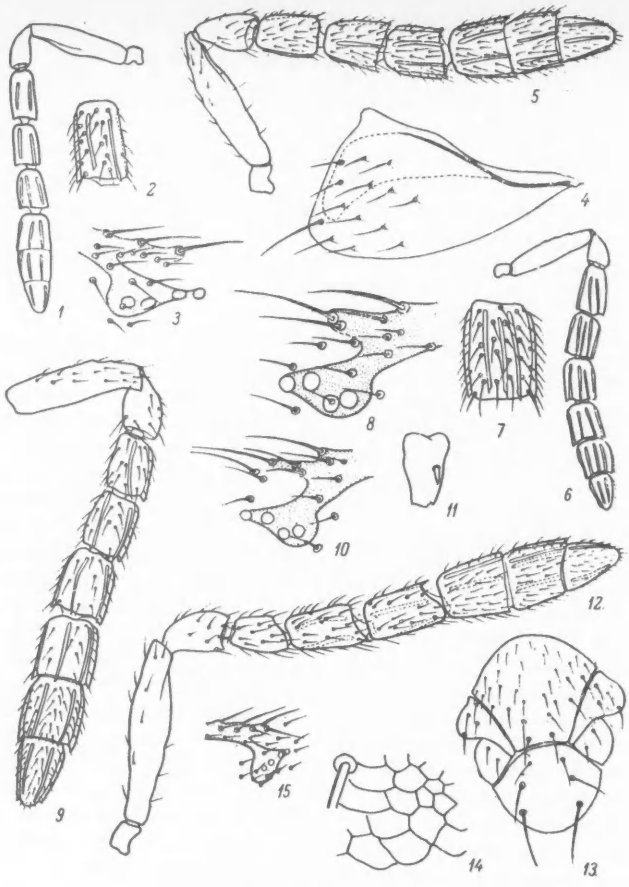


Fig. 1,2,3,4,5) Coccophagus japonicus Comp., female (1) antenna, 2) second funicle segment, 3) part of venation, 4) outer plate of ovipositor, 5) antenna of deviant form); 6,7 and 8) Coccophagus hawaiiensis Timb., female (6) antenna, 7) second funicle segment, 8) part of venation); 11,12,13,14 and 15) Coccophagus chengtuensis Sug. et Peng., sp. n., Female (11) mandible, 12) antenna, 13) mesonotum, 14) sculpture of scutellum, 15) part of venation).

ferent variants as regards leg coloration are cited by Compere [1931]. Apart from females with the proportions of the antennal segments typical of C. japonicus (Fig.1) there were also specimens deviating from the usual variants as regards this characteristic (Fig. 5). In these the first funicle segment was only a little longer than the pedicel and slightly longer than, or almost equal to, the other two segments of the funicle. Nontypical specimens were bred out on September 3-14, 1958 from larvae of the Japanese wax (Ceroplastes japonicus Green) collected on Gardenia sp. in Chengtu. It is a parasite of the soft scale (Coccus hesperidum L.), the Japanese wax scale and Chloropulvinaria sp. The emergence of adult parasites from second-instar larvae and adult females of the soft scale and Chloropulvinaria was observed between June 22 and July 8, and from the larvae of the Japanese wax scale between August 21 and and October 8. The latter was generally very slightly infested. It has not hitherto been recorded as a parasite of this scale. After Coccophagus yoshidae, C. japonicus is the second most abundant parasite of the soft scale.

Information on the hosts and a bibliography are given by Tachikawa [1957].

2. Coccophagus hawaiiensis Timb. (Figs. 6-8).

Very common in the districts of Fayang, Tingtang and in the neighborhood of Chengtu, but is nowhere found in large numbers. It has not yet been recorded from other districts of the province. The parasite is fairly polyphagous; it has been bred out from Chloropulvinaria polygonata Ckll., Chloropulvinaria sp., and

Ceroplastes japonicus, but the role of the parasite in controlling the numbers of these scales is not very great. Two periods of flight of the parasite were noted: the first from Ch. polygonata – from July 8 to August 18, the second from C. japonicus and C. rubens – from September 17 to October 14.

Information on the hosts and a bibliography are given by Tachikawa [1957].

3. Coccophagus sp. (Fig. 9, 10).

Chengtu: 17/IX/1958, 2 ♀♀, from Ceroplastes japonicus; 13/VII/1958, 1 ♀, from Chloropulvinaria polygonata.

Female. Pedicel subequal (a little shorter or longer) to first funicle segment, the latter equal to or slightly longer than second, third funicle segment longest. Club longer than funicle, first club segment subequal to second and shorter than third. Scutellum slightly shorter than mesoscutum, broader than long. Mid tibial spur equal to first mid tarsal segment. Base of ovipositor reaching hind margin of third visible abdominal tergite. Ovipositor exserted. Body black or dark brown, part of scutellum yellowish. Legs brown or brownish, mid and hind coxae at apices, hind femora at base, most of mid tibiae, and hind tibiae in apical half, more or less whitish. Tarsi slightly darkened. Length 0.8 mm.

Similar to C. hawaiiensis, from which it differs in the different ratio of the antennal segments. Apparently rather variable. For a final judgment on this species a study of additional material is necessary.

A parasite of the Japanese wax scale and Chloropulvinaria polygonata. Rare.

4. Coccophagus chengtuensis Sugonjaev et Peng, sp. n. (Figs. 11-18).

Chengtu: 30/VI/1958, 2 ♀♀ (including holotype), 1 ♂ (allotype); 30/VI - 8/VII/1958, 2♀♀; 1/VII/1958, 2 ♂♂; 11/IX/1958, 1♀; 14/X/1958, 1♀; 24/VII/1958, 2♀♀; 10/IX/1958, 2♀♀ from Chloropulvinaria sp. on oleander; 24/IX/1958, 2♀♀, from Ceroplastes japonicus on apple. Fayang: 13/VII/1958, 2 ♀♀, from Chloropulvinaria sp. on mandarin.

Female. Distance between lateral ocelli three times the distance between them and the inner orbits of the eyes and one and a half times the distance to edge of occiput. Pedicel longer than first funicle segment. Second funicle segment a little less than one and a half times longer than first and slightly longer than third, less than twice as long as broad. Club elongate-oval, a little shorter than funicle, subequal in length to scape, first club segment a little longer than other two, second segment a little shorter or equal to third. Scutellum one and a half times broader than long and a little more than two-thirds length of mesoscutum. Radius with rather long stalk, postmarginal vein short. Mid tibial spur approximately one and a half times as long as first mid tarsal segment. Abdomen a little longer and broader than thorax. Ovipositor barely exserted. Outer plates of ovipositor a little less than three times as long as broad. Ovipositor sheaths rather long, a little more than half the length of the inner plates of the ovipositor. Base of ovipositor reaching hind margin of third visible abdominal tergite. Head orange-yellow, cheeks whitish with bluish luster, occiput with two brownish spots. Antennae orange-yellow, scape whitish in basal half. Thorax orange-yellow above, yellow below. Pronotum in middle brownish, sides and fore margin of mesoscutum faintly brownish, parapsides and axillae with brownish spots anterad, hind margin of propodeum sometimes brownish. Legs yellow or whitish, fore tarsi darkened. Wings hyaline. Abdomen entirely yellow or with brownish spots on sides of each tergite, fourth and fifth visible tergites with light brownish bands. Length 1.0-1.2 mm.

Male. Pedicel broader than long. Funicle segments articulating laterally, as broad as long or a little longer than broad, subequal to each other in width and length. Club as long as funicle, its segments gradually constricting towards apex, subequal in length. Vertex orange-yellow, darkened in region of ocelli, with two brownish spots behind lateral ocelli. Face yellowish white, cheeks white, with bluish luster. Scape white, antennae yellow, sensillae blackish. Thorax brown, sides and part of hind margin of mesoscutum, parapsides with exception of apices, longitudinal stripe in center of scutellum, and parts of thorax, orange-yellow or yellow. Legs white, hind tibiae darkened at base. abdomen brown, second and third visible abdominal tergites paler in center. Length 0.6-0.8 mm.

It is distinguished from the closely related C. ochraceus How. (S. Africa) by the following characteristic (females):

C. ochraceus How.	C. chengtuensis, sp. n.
1. Lateral ocelli separated from inner orbits of eyes by a distance equal to several times their diameter, and less distant from margin of occiput.	1. Lateral ocelli separated from inner orbits of eyes by a distance a little longer than their diameter, and a little more distant from margin of occiput.
2. First funicle segment a little less than twice as long as broad.	2. First funicle segment a little longer than broad.

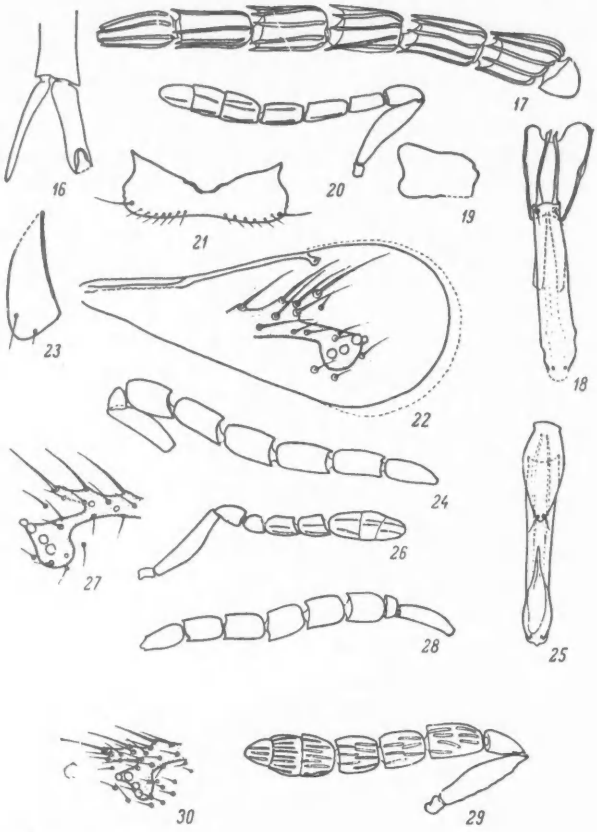
A parasite of larval males and, possibly, females of Chloropulvinaria sp. living on oleander, and of the Japanese wax scale.

The role of the parasite in reducing the numbers of its host is relatively small.

5. Coccophagus viator Sugonjaev, sp. n. (Figs. 19-25) Tingtang: 26/VII/1958, 1♂ (allotype). Chengtu: IX/1958, 6♀♀ (including holotype), 2♂♂.

Female. Pedicel equal to first funicle segment, the last shortest, twice as long as broad, second funicle segment longest, two and a half times as long as broad, third almost twice as long as broad. Club elongate-oval, a little shorter than funicle, first segment of club longest, second segment a little shorter than third. Scutellum a little less than two-thirds length of mesoscutum and broader than long. Mesoscutum almost as long as broad. Mid tibial spur slightly longer than first segment of mid tarsus. Wings rather large, extending beyond apex of abdomen. Abdomen as long as thorax. Ovipositor exserted. Outer plates of ovipositor almost two and a half times as long as broad. Ovipositor sheaths longer than in preceding species, a little more than half the length of inner plates of ovipositor. Base of ovipositor reaching middle of third visible abdominal tergite.

Vertex orange-yellow, margin with brownish spots behind ocelli; temples, cheeks and face whitish, with bluish luster, eyes rimmed by bluish streaks, occiput with two brownish spots. Antennae blackish, pedicel orange, darkened at base, scape white, orange and darkened along upper margin at apex. Thorax orange, pro-



Figs. 16-30.
16,17,18) Coccophagus chengtuensis Sug. et Peng, sp. n. (16—parts of mid tibia and tarsus of female, 17- antenna, 18- male genitalia); 19,20,21,22,23,24, and 25) Coccophagus viator Sug., sp. n. (19—mandible, 20-antenna, 21- pronotum, 22-forewing and venation, 23-outer plate of ovipositor, 24-antenna, 25-male genitalia); 26, 27 and 28) Coccophagus? longifasciatus How. (26-antenna, 27-part of venation of female forewing, 28-male antenna); 29,30) Coccophagus yoshidae Nak., female (29-antenna, 30-part of venation).

notum with large blackish spots in center and small ones on sides, axillae, fore margin and sides of propodeum and sides darkened, the last slightly. Legs white, mid coxae entirely, hind coxae at base, brownish; fore tibiae yellowish, fore tarsi darkened, tibiae of fore and mid legs with blackish markings. Wings hyaline. First two to three visible abdominal tergites white, rest brown, apex paler, brownish orange; abdominal sternites white, hyaline, in the last dark brown. Outer and inner ovipositor plates dark brown. Length 1.0-1.2 mm.

Male. First funicle segment slightly shorter and broader than second and third, less than one and a half times as long as broad, second and third funicle segments subequal in length, one and a half or a little more than one and a half times as long as broad. Club equal in length to funicle, club segments subequal in length. Radius with long stalk, postmarginal vein present. Mid tibial spur a little longer than first mid-tarsal segment. Vertex orange, face and cheeks white, with bluish luster, occiput partially brown. Antennae yellowish, sensillae black, scape white. Thorax brown, the greater part of the parapsides, sides and spot on apex of scutellum, sides of mesothorax and greater part of thorax, orange or orange-yellow. Sides of mesoscutum sometimes yellowish-brown. Legs white, mid and hind coxae brown or brownish, mid tibiae at base above, hind tibiae entirely brownish, the latter with blackish stripe on upper margin, not reaching apex. Fore tarsi darkened. Wings hyaline, veins brownish. Abdomen brown, white at base, orange at apex, basal tergites paler than rest, abdomen white below, apical sternites with black spots on sides, genitalia blackish. Length 0.9-1.2 mm.

It differs from the closely related C. argentifascia Gir. (Australia) in the following main characteristics (females):

C. argentifascia Gir.	C. viator, sp. n.
1. Forewings small and very narrow.	1. Forewings rather large and broad.
2. Antennae lemon yellow.	2. Antennae dark brown or blackish.

A parasite of lecaniine scales. The male from Tingtang was bred out in an emergence box in which were laid branches of orange, infested by several species of scales at once. Rather rare.

6. Coccophagus? longifasciatus How. (Figs. 26-28).

Chengtu: 10/VIII/1958, 1♀; 13/VIII/1958, 1♂; 15/VIII/1958, 2♂♂; 19/VIII/1958, 3♂♂; 10/IX/1958, 1♂, 3 ♀♀; 12/IX/1958, 1♀; 16/IX/1958, 1♀, from Ceroplastes japonicus on Gardenia jasminoides Ellis.

C. longifasciatus was described by Howard [1907] from specimens bred out from the lecaniine scale Saissetia nigra Nietner in Ceylon. Later Compere [1931] identified specimens collected by Sylvestri in China as C. longifasciatus, but pointed out that the identification was not positive. Our specimens are obviously identical with those described by Compere.

A parasite of the first- and second-instar larvae of the Japanese wax scale. Apparently rare.

7. Coccophagus yoshidae Nak. (Figs. 29-30).

A species widely distributed in Szechwan. It has been recorded, in particular, from Chengtu, Nangchung, in the districts of Fayang and Tingtan. The usual parasite of Chloropulvinaria polygonata am Chloropulvinaria sp. In Tingtang District it was several times recorded as a parasite of the soft scale, which was rather heavily infested. It is of interest that C. yoshidae was not bred out of the soft scale in Chengtu, but always emerged from the mummies of Ch. polygonata. The flight of the adult parasites was continuous from June 22 to August 1. C. yoshidae infests female scales; up to four parasites develop in one individual. According to our surveys, the percentage infestation of Ch. polygonata by the parasite reached 80%. However, the larvae of C. yoshidae do not mummify the host before the latter has succeeded in laying a considerable number of eggs – up to 500, i.e., half as much as uninfested females. As a result of this the role of the parasite in reducing the damage caused by Ch. polygonata is a relatively minor one – this pest causes considerable damage to citrus trees. Information on the hosts and a bibliography is given by Tachikawa [1957].

SUMMARY

A key to 7 species of the genus Coccophagus Westw. (fam. Aphelinidae) and descriptions of two new species: C. chengtuensis, sp. n., and C. viator, sp. n., are given. All of them are found in Szechwan Province, China. Brief information on the distribution and biology is given for all the species mentioned.

LITERATURE CITED

H. Compere, "A revision of the species of Coccophagus, a genus of Hymenopterous coccid-inhabiting parasites," Proc. U. S. Nat. Mus. 78, 7:1-132 (1931).

L. O. Howard, "New genera and species of Alphelininae, with a revised table of genera," U.S.D.A., B.E. Tech. Ser. 12, Pt. IV, 69-88 (1907).

T. Tachikawa, "The Japanese species of the genus Coccophagus and their hosts (Hymenoptera, Aphelinidae), "Japanese Journ. Appl. Ent. Zool. 1, 1 :61-64 (1957).

REPRESENTATIVES OF THE GENUS PRAON (HYMENOPTERA APHIDIIDAE) IN HUNGARY

J. Györfi

Forestry Institute, Sopron, Hungary
Translated from Éntomologicheskoe Obozrenie, Vol. 39, No. 3, pp. 708-712, July-September, 1960

The genus Praon was erected by Haliday in 1833. The characteristics of this genus are as follows.

Head almost spherical. Maxillary palps four-segmented, labial palps three-segmented. Mandibles long, bidentate. Parapsidal furrows distinct, converging caudad. Pterostigma broad, triangular. Radius arising from center of lower part of pterostigma, weakly arcuate. First cubital cell and discoidal cell separate from one another; no transverse cubital veins. Nervulus postfurcal (see Fig.). In hindwing the humeral cell is closed. Abdomen almost sessile. First tergite rather short, but with distinct lateral tubercles. Ovipositor directed slightly upwards; ovipositor sheaths pointed.

Ten palaeartic species belong to this genus. In Hungary I found seven species.

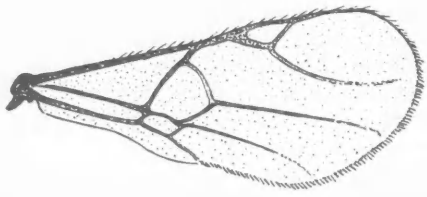
Type of genus—Praon volucre Nees.

KEY TO SPECIES OF GENUS PRAON FOUND IN HUNGARY

1 (2) Female antennae 13- to 18-segmented, usually 14-segmented; male antennae 15- to 18-segmented, longer than body. Color black; abdomen brown, last tergite almost black; legs yellowish red; hind femora, middle of hind tibiae and all segments of hind tarsi blackish; wings almost hyaline; tegulae black; pterostigma pale greyish, triangular. 1.5-2 mm . . . . . abjectum hal.

2 (1) Female antennae 18 to 21-segmented, male 21- to 23-segmented. Usually larger species.

3 (4) Abdomen yellowish red. Head much wider than thorax. Thorax smooth, parapsidal furrows distinct. Head and thorax black; first to third segments of antenna yellow; legs yellow; claw segments black. Wings almost glass-clear; pterostigma yellowish brown. Male antennae 23-segmented, yellowish red. End of abdomen lanceolate 1-1.3 mm . . . . . exoletum Nees.



Praon sp., anterior wing.

4 (3) Abdomen black or brown or first segment yellowish. Larger species.

5 (6) Wing with a smoky spot under radial cell. Head almost cubical, rounded and smooth behind eyes. Parapsidal furrows distinct, converging caudad. Palps very long. Antennae 20- to 21-segmented. Wings long. Abdomen ovate, pointed at apex. Color yellowish brown; thorax reddish yellow below; legs yellowish red; pterostigma light brown. Ovipositor short, sheaths black. 2-2.5 mm. Female unknown. . . . . dorsale Hal.

6 (5) Wing lacking smoky spot under radial cell. Wings completely hyaline or uniformly darkened.

7 (8) Male and female antennae 22-segmented, much longer than body. Head almost cubical. Parapsidal furrows distinct. First and second antennal segments reddish yellow; mouth region and palps red; head and thorax black; abdomen dark brown; first tergite red, last yellowish red; legs yellowish red; wings hyaline; pterostigma pale reddish yellow. 2-2.5 mm. . . . . longicorne Marsh.

8 (7) Antennae not longer or a little longer than body (in male), or color of antennae otherwise.

9 (10) Female antennae 18- to 19-segmented. First tergite entirely or only apically, second tergite entirely or only basally, yellowish red; other tergites dark brown. Head and thorax black above; cheeks and venter of thorax yellowish red; legs pale red; wings hyaline, pterostigma pale yellow. 2-2.3 mm. Female unknown. . . . . flavinode Hal.

10 (9) Female antennae 19-, male 21- to 22-segmented.

11 (12) First tergite dark brown; second and third a little lighter, more reddish brown; head and thorax almost black; first and second antennal segments yellow; wings hyaline, pterostigma brown. Male antennae 22-segmented. 2-2.5 mm . . . . . volucre Nees.

12 (11) First tergite black, pale ochreous yellow only posteriorly. Legs pale yellow. 2.9-3.1 mm . . . . . absinthii Bign.

1. Praon abjectum Hal.

Aphidius abjectus Haliday. 1833. Entom. Magaz., I: 485, n. 5, ♀.
Praon abjectum Marshall. 1896. Spec. Hymén. Europé, V: 53, 534.
Praon abjectum Szépligeti. 1904 Genera insect. 22: 184.
Praon abjectum Péretz 1934. Eos. X: 159.

Head transverse, rounded and smooth behind eyes; cheeks smooth. Antennae 13- to 18-segmented. Parapsidal furrows weak, converging caudad. Propodeum smooth, with no special areas. Pterostigma triangular; radius arising from center of lower part of pterostigma; basal third of radius very distinct, remainder diffuse; first cubital and discoidal cells separate from one another; first and second transverse cubital veins absent. Parallel vein interstitial. Abdomen a little longer than head and thorax together. Tergite of first abdominal segment one and a half times longer than broad, smooth behind. Tergites of remaining segments more or less punctate. Ovipositor displaced forward, black abdomen brown, second suture pale brown; last tergite almost black; mouth region and palps brownish; antennae black; legs yellowish red; wings almost hyaline; pterostigma pale grey; tegulae black. Male antennae 15- to 18-segmented, black, longer than body. 1.5-2 mm.

A parasite of the aphids Macrosiphon epilobii M. hieracii Kalt., Dysaphis anthrisci CB, Hyperomysus lactucae L. and Smynthurodes betae Wert.

Flight period: May-August.

Distribution: All Europe; in Hungary it has been recorded in many localities, particularly in Transdanubia.

2. Praon absinthii Bign.

Praon absinthii Bignell. 1894. Entom. Mont. Mag. 30: 255, ♀♂.
" " Szépligeti. 1904. Genera insect., 22: 184

Antennae 19-segmented. Black; mouth-region, large part of abdomen, last segments of tarsi, antennae excluding apex, thorax and legs, yellow; at apex of first abdominal tergite and at base of second a yellow rectangular spot is visible. Female darker, antenna with 21 segments. 3 mm.

A parasite of Macrosiphoniella absinthii L.

Flight period: June-July.

Distribution: Western and Central Europe; recorded in the village of Szed in Hungary.

3. Praon dorsale Hal.

Aphidius dorsalis Haliday. 1833. Entom. Magaz. I: 484, n. 1, ♀.
" " Thomson. 1895. Opusc. Entom., 20: 2333, n. 6, ♀.
Praon dorsale Marshall. 1896. Spec. Hymén. Europé, V, 53: 536, ♀.
" " Szépligeti. 1904. Genera insect., 22: 184

Head almost spherical, rounded and smooth behind eyes. Palps very long and slender, antennae 20- to 21-segmented. Parapsidal furrows present, converging caudad. Abdomen ovate, slightly pointed at apex. Tergite of last abdominal segment almost straight, almost twice as long as posterior width. Ovipositor short, displaced forward. Color blackish brown; thorax reddish yellow below, clypeus and lower part of cheeks reddish brown; legs reddish yellow; wings hyaline, with a smoky spot under radial cell. Ovipositor sheaths black. 2-2.5 mm.

Male: not known.

Host: an unidentified aphid.

Flight period: May- August.

Distribution: in Northern and Central Europe; in Hungary it was found in the towns of Vác, Budapest and Ocsa.

4. Praon exoletum Nees.

Bracon exoletum Nees. 1811. Magaz. Ges. Naturf. Fr. Berlin, V: 30, n. 47, ♀♂.
Aphidius exoletus Nees. 1818. Nova acta acad. nat. curios., IX: 302.
" " Haliday 1833. Entom. Magaz., I: 261, 484, n. 2, ♀♂.
" " Nees. 1934. Hymen. Ichneum. affin Monogr., I: 25, n. 14, ♀♂.
" " Nees. idem: 398.
" " Bouché. 1835. Naturg. Insect.: 162 n. 51, ♀.
" " Wesmael. Nouv. Mém. Acad. Sc. Bruxelles, IX: 8i, n.4, ♀.
Praon exoletum Blanchard. 1840. Hist. Nat. Insect., III: 347.
Aphidius exoletum Ratzeburg.1848. Ichneumon, Forstins., II: 59, n. 3, ♀.
" " Ratzeburg. 1852. idem, III: 63, n. 6, ♀.
Praon exoletum Marshall. 1896. Spec. Hymén. Europé, V, 53: 535, ♀♂.
" " Szépligeti. 1904. Genera insect., 22: 184.

Head transverse, much broader than thorax. Head and thorax smooth. Parapsidal furrows distinct converging caudad. Propodeum smooth. Abdomen semisessile, ovate, as long as head and thorax together; first abdominal tergite straight, very finely rugose, almost twice as long as posterior width; tergites of other segments smooth. Ovipositor sheaths flat, pointed at end. Head and mesonotum black; fore part of body dark reddish yellow; first to third antennal segments yellow; legs yellow; claw segment black; wings hyaline; pterostigma pale brown. Male similar to female. Male antennae 23-segmented, yellowish red; hind part of head black. Abdomen lanceolate, pointed. 1-1.3 mm.

Hosts: Drepanosiphum platanoides Schrank., Macrosiphon rosae L., Schizoneura ulmi F.

Flight period: May - July.

Distribution: A great part of Europe; recorded only

in a few localities in Hungary, mainly in the regions of Sopron, Budapest and Pécs.

5. Praon flavinode Hal.

Aphidius flavinodis Haliday. 1833. Entom. Magaz. I: 484, n.4,♀.

Praon flavinode Marshall. 1896. Spec. Hymén, Europé, V, 53: 537, ♀♂.

" " Szépligeti. 1904. Genera insect., 22: 184.

Head almost spherical, rounded and smooth behind eyes; cheeks also smooth Antennae 18- to 19-segmented, almost moniliform. Thorax smooth, parapsidal furrows distinct, converging caudad; propodeum almost smooth. Pterostigma broad, triangular. Radius arising from center of lower margin of pterostigma; radius distinct only in fore third; recurrent vein interstitial; nervulus slightly postfurcal; medial also interstitial. Abdomen lancedate, first tergite one and a half times as long as posterior width, constricting anterad, smooth. Abdominal segments, beginning at base of third segment, flattened on venter. Ovipositor displaced forward. Color brownish-black; cheeks and thorax reddish; palps yellow; propodeum reddish brown; tergite of first abdominal segment and base of second brown; hind femora blackish; wings hyaline; pterostigma pale yellowish; legs pale yellow. Male smaller in size and darker in color; its antennae 22-segmented. 2-2.1 mm.

A parasite of the aphids Eucalipterus tiliae L., Macrosiphonella absinthii L., Sitobium avenae F., and Aphidula pomi Deg.

Flight period: May-August.

Distribution: all Europe; frequently occurs in Hungary, recorded from many localities.

6. Praon longicorne Marsh.

Praon longicorne Marshall. 1896. Spec. Hymén. Europé, V, 53: 537, ♀♂.

Praon longicorne Szeplegeti, 1904, Genera insect., 22: 184.

Head almost spherical, rounded and smooth behind eyes. Antennae filiform, 22-segmented, much longer than body. Thorax smooth. Parapsidal furrows distinct, converging caudad. Propodeum smooth, with sparse white pubescence. Wings large. Abdomen a little longer than head and thorax together, lanceolate; first abdominal tergite straight, a little convergent anterad almost twice as long as posterior width, longitudinally rugose. Ovipositor short, displaced forward. Head and thorax black; abdomen pitch brown; first abdominal tergite reddish, black at base; second tergite reddish yellow; wings hyaline; pterostigma pale yellow; tegulae ochreous yellow; wing veins brown; mouth region and palps yellowish red; first and second antennal segments reddish yellow. Male similar to female; antennae 22--segmented, longer than body. Abdomen shorter than head and thorax together. First abdominal tergite black, second yellowish red; tergites of other segments brown; legs pale yellow. 2-2.3 mm.

A parasite of Aulacorthum ilka Mordv.

Flight period in Hungary: June-July.

Distribution: Northern and Central Europe; recorded from Vác in Hungary.

7. Praon volucre Hal.

Aphidius volucris Haliday. 1833. Entom. Magaz., 1: 484, n. 3, ♀♂.

Praon volucre Ruthe. 1854. Stettin. Entom. Zeitg., XX: 315, n. 23, ♀.

" " Förster. 1862. Verh. Naturh. Ver. Preuss. Rheinl., XIX: 248.

Aphidius volucris Thomson, 1895, Opusc. Entom., 20: 2333, n. 7, ♀♂.

Praon volucre Marshall. 1896. Spec. Hymén, Europé, V, 53: 539, ♀♂.

" " Szépligeti. 1904. Genera insect., 22: 184.

Head almost spherical, rounded behind eyes. Cheeks smooth, slightly compressed laterally. Clypeus smooth, convex. Antennae 19-to 21-segmented, shorter than body; antennal segments longer than broad, monoliform. Thorax smooth. Parapsidal furrows weak, converging caudad. Scutellum convex, smooth propodeum almost smooth. Pterostigma broad, triangular. Radius arising from center of pterostigma. Recurrent vein interstitial. Abdomen lanceolate. First abdominal tergite straight, twice as long as posterior width, weakly longitudinally rugose; tergites of remaining segments smooth. Ovipositor directed forward, sheaths sharp. Color black or brownish black; first and second antennal segments yellowish; abdomen blackish brown, hind legs darkened; wings hyaline; pterostigma brown. Male similar to female. Its antennae 22 to 23-segmented. First and second antennal segments pale brown; legs darker than in females. Abdomen a little shorter than head and thorax together, expanded caudad, clavate. 2-2.5 mm.

A parasite of Tuberculoides annulatus Htg., Dactynotus sonchi L., Aulacorthum ilka Mordv., Macrosiphonella absinthii L., Aphidula pomi Deg., Macrosiphonella absinthii L., Aphidula pomi Deg., Cinara cembrae Str.

Flight period: April-September.

Distribution: all Europe, Western and Central Asia, China; it is the commonest species of the genus Praon in Hungary and occurs everywhere.

FLIES OF THE GENUS CONOPHORUS MEIG. (DIPTERA, BOMBYLIIDAE) IN THE TRANSCAUCASIAN FAUNA

V. F. Zaitsev

Zoological Institute, Academy of Sciences, USSR, Leningrad
Translated from Entomologicheskoe Obozrenie, Vol. 39, No. 3, pp. 713-724, July-September, 1960

The genus Conophorus Meigen was erected by Meigen in 1803 with Bombylius maurus Mikan=Conophorus virescens F. as the type of the genus. According to Paramonov [1939], this genus is distributed in the Palaearctic, Nearctic and Ethiopian regions, but it attains its greatest diversity of species in the southern regions of the Palaearctic; the number of species found here is 38 (Paramonov [1940]).

In the present paper I have attempted a revision of the species of the genus Conophorus Meig. occurring in Transcaucasia. My material consisted of the collections of the Zoological Institute of the Academy of Sciences, USSR, the Zoological Institute of the Academy of Sciences, Arm. SSR, as well as collections made by the author and other persons over several years in various parts of the Caucasus. The author takes this opportunity of expressing his thanks to A.A. Shtakel'berg for guidance in this work.

CONOPHORUS Meigen

Meigen, 1803, in Illiger's Magaz. f. Ins., II: 268;—Ploas Latreille, 1804, Hist. Nat. Crust., Ins., XIV: 299.

Type of genus—Conophorus virescens F.

Distinctive characteristics-posterior cell I open; antennal segment I very thick, several times as thick as segments II and III; antennal segment III slender, long; thorax and abdomen lacking typical macrochaetae; legs always wtih short spinules.

Small or moderate-sized species. Body black, with dense silky, or coarser and sparser pilosity, covered with golden or silver scales. Thick segment I and small and thinner segment II of antenna usually with dense hairs, often forming a characteristic brush on the ventral surface of segment I. Antennal segment III usually bare and narrow, spindlelike or slightly bent, with two-segmented style at apex. The shape and size of the antennae in some cases provide good species characteristics (C. virescens F. and C. rossicus Param.). Eyes in ♂ always contiguous, in ♀ separated by the wide frons. Mouth opening broad; mouth margin and face not protruding. Proboscis of moderate size, usually extending beyond antennal segment II. Palps one-segmented, reaching halfway along proboscis. Thorax normally developed, without coarse macrochaetae, with only the usual bristles and hairs. Pleura in many species almost bare. Scutellum black, mat or shining, in some depressed in center. Legs stout, of moderate size; femora with no bristles, only hairs; dark bristles present on other parts of legs. Mid tibiae with stout spur at apex. Pulvilli well developed, usually reaching end of claws. Wings with three or four radial cells, transparent, darkened or maculate. Fore margin of wing usually beset with bristles, and in some species with spinules. Vein rm placed above the proximal half of the discoidal cell. Posterior cell I and anal cell always open. Color of halteres from white to black (in some cases providing specific or sexual differences). Abdomen elongate, constricting apically, covered with hairs, much denser and often forming tufts on sides of abdomen. Tergites covered with a coat of scales and often with coarser bristly hairs on hind margin.

A study of the male and female genitalia showed that the male hypopygium in several cases provides distinct specific differences, whereas the limits of variability in the females overlap in closely related species.

Hypopygium in males not inverted.* Epandrium (tergite IX) of fairly constant shape, covered with bristles and hairs, united to gonocoxites by a long narrow outgrowth of its lateral margin (Figs. 18, 19). Cerci of moderate size; their distal half more strongly sclerotized than their base. Anal orifice opening between cerci. Cavity between epandrium and gonocoxites covered by a membrane. Phallus simple; its distal half very constricted and always pointed at end. A more or less distinct protuberance on the ventral surface of the distal half is sometimes present. Apodeme of ejaculator very flattened at end and in lateral aspect appearing as a more or less regular circle. Hypandrium (sternite IX) always in the form of an isolated semicircular or triangular plate at base of gonopods; within a species it may may vary in size and in some cases also in shape, but its range of variation never overlaps that of the next closest species. Gonopods two-segmented, consisting of gonocoxites and gonostyles. Gonocoxites of usual form for the family Bombyliidae, covered with hairs and bristles; their distal end rounded, with no projections.

*The terminology of the parts of the hypopygium is taken from Emden and Hennig [1956].

Gonostyles large, in the form of a produced spine, covered with tiny hairs and bristles, fairly constant in shape, with an acute, more or less blunt, or truncate apex, and may have various small swellings or excavations on their outer and inner surfaces.

Thus, good specific differences in the male hypopygium are provided by: the gonostyles (shape and nature of their apex, presence or absence of swellings or excavations on outer and inner surfaces), shape and size of hypandrium and apodeme of ejaculator, relation between distal slender end of phallus and its broad basal part.

The following may be regarded as generic differences: male hypopygium not inverted (in other genera, such as Dischistus, Prorachthes, Bombylius and Systoechus, the hypopygium is rotated a varying number of degrees round the long axis of the body); epandrium united to gonopods by a long extension of its lateral margin; no epiphallus (in the genera Dischistus, Bombylius and Systoechus it attains varied degrees of development); phallus constricting distinctly towards end and pointed; its basal half thick and broad; hypandrium distinct and separate from gonocoxites (in Prorachthes it is fused with the latter); distal end of gonocoxites round, without projections; gonostyles even throughout their length, not sinuous at apex.

The biology of species of this genus has not been investigated so far, although some species are fairly common even in the central regions of the European USSR. In the Caucasus the adult flies begin to appear in April both in virgin areas and on the edges of wheat fields. The flight period occurs in spring and eary summer. The preferred plants are various species of Umbelliferae.

From an examination of the material of the genus Conophorus nine species were established for Transcaucasia. The species Conophorus monticola Param., which we include in our key, has been recorded so far only from Turkman and Iran but, judging from the recorded distribution, we are justified in expecting that it will be found in Transcaucasia too.

KEY TO SPECIES OF GENUS CONOPHOROUS MEIG. IN TRANSCAUCASIA

1 (14) Wing with three radial cells.

2 (11) Vein r_{2+3} terminating in fore margin of wing, deflected slightly towards wing base, and with a distinct bulge forward before the distal bend (Figs. 1–7).

3 (4) Middle third of fore margin of wing with distinct spinules. Hairs on sides of abdomen and on hind margin of scutellum characteristic, coarse and black in basal half, finer and white at apex. Pilosity whitish, body black, with no adpressed golden coat. Hypandrium small, in the shape of an isosceles triangle. Gonostyles with small swelling on inner side at apex (Figs. 8, 17-19). Turkmen, Iran . . . .1. C. monticola Param. (only ♂).

4 (3) Fore margin of wing with hairs only. Hairs on body normal, unicolorous.

5 (8) Males.

6 (7) No black bristles in front of wing base. Mesonotum without black hairs. Pilosity of body lemon yellow. Hypandrium narrow, strongly produced in the transverse direction, with round apex (Figs. 1, 16, 20-22). Transcaucasia, Turkey, Iran. . . . . 2. C. nobilis Lw. ♂

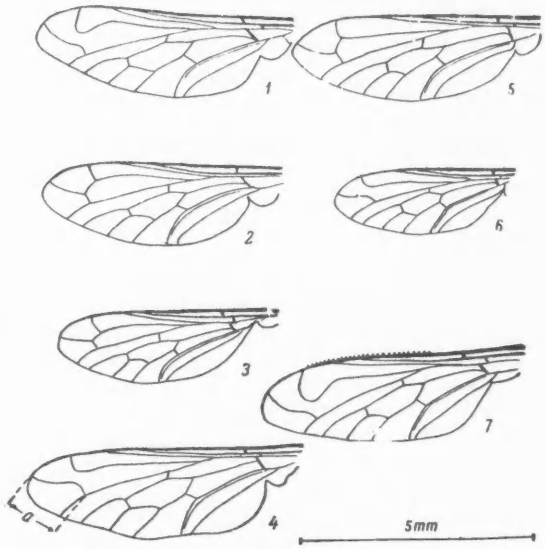
7 (6) One to two black bristles in front of wing base. A few black hairs on mesonotum. Pilosity of body yellowish white. Hypandrium expanded in longitudinal direction, in form of an isosceles triangle (Figs. 23-25). Transcaucasia, Central Asia . . . . . 3. C. paraduncus Param. ♂

8 (5) Females.

9 (10) Halteres yellow, at most the capitellum slightly greyish . . . . . 2. C. nobilis Lw. ♀

10(9) At least the capitellum brown or black. . . . . 3. C. paraduncus Param. ♀

11(2) Vein r_{2+3} almost straight up to its most distal bend. Scutellum black, shining, as if polished.†



Figs. 1-7. Wings: 1) Conophorus nobilis Lw.; 2) C. caucasicus, sp. nov.; 3) C. talyshensis, sp. nov.; 4) C. syriacus Param.; 5) C. virescens F.; 6) C. rjabovi Param.; 7) C. monticola Param.

†C. simplex Lw (known only from male) occurs in Turkey. The range of this species probably extends into south Transcaucasia. It is characterized by the following features; scutellum mat, with only weak luster, capitellum of haltere black, wings transparent, hairs on underside of femora pale. We do not know this species in real life.

12(13) Smaller—up to 5 mm. Always a distinct tuft of black hairs on lower half of occiput at edge of eyes. Hairs on mesonotum sparse, black. Vein r_4 issuing from vein r_5 at an acute angle (Fig. 6). Distal end of phallus shorter. Outer surface of gonostyles with no excavation before apex; end of gonostyles narrowing evenly to a point and slightly curved (Figs. 26-28). Caucasus . . . . . C. rjabovi Param. ♂ and ♀.

13(12) Larger—more than 8 mm. Entire occiput covered with pale hairs only; black hairs present only on margin of eyes and never forming distinct tufts on occiput. Mesonotum covered with pale hairs with only a few black ones. Vein r_4 issuing from vein r_5 at a right angle (Fig. 4). Distal end of phallus long and slender. A distinct excavation before the apex on the outer surface of the gonostyles; end of gonostyles obliquely truncate (Figs. 29-31). Transcaucasia, Asia Minor . . . . . 5. C. syriacus Param. ♂ and ♀

14(1) Wing with four radial cells. Vein r_{2+3} straight or slightly bent before distal bend.

15(16) Apex of scutellum divided in center, so that scutellum is in the form of two humps divided by a deep groove covered with light scales. Halteres yellow, wings transparent. Mesonotum with sparse black and shorter pale hairs. Abdomen with adpressed golden coat, light hairs and with long black hairs on hind margin of tergites. Hypandrium in male narrow, crescentic. Gonostyles narrowing evenly to a point (Figs. 10, 32-34). Southern Europe, Caucasus . . . . . 6. C. glaucescens Lw. ♂ and ♀.

16(15) Scutellum normal, with no impression in middle, black, highly shining.

17(20) Halteres yellow. Fore margin of wing with simple hairs, without spinules.

18(19) Wings very dark, almost black, on fore margin and at base. Pilosity of body with a predominance of black hairs and a scattering of sparse and short white ones. Tuft of hairs and bristles in front of wing base, and bristles and hairs on the coxae, entirely black. Ventral surface of haltere in males dark brown. Line of bisection of eyes three and a half times longer than ocellar tubercle.** Hypandrium in male broad, in form of isosceles triangle. Apodeme of ejaculator small, projecting slightly beyond gonopods (Figs. 35-37). Transcaucasia . . . . . 7. C. talyshensis, sp. n., ♂ and ♀.

19(18) Wings almost transparent, most greyish at very base in male. Body clothed with long black and shorter yellow hairs. Tuft of hairs and bristles in front of wing base with a considerable admixture of yellow hairs. Only pale hairs and bristles on coxae. Halteres entirely pale yellow in both sexes. Line of bisection of eyes two to two and a half times longer than ocellar tubercle. Hypandrium in male narrow, crescentic. Apodeme of ejaculator large, projecting well beyond gonopods (Figs. 15, 38-40). Transcaucasia. . . 8. C. caucasicus, sp. n., ♂ and ♀.

20(17) At least capitellum black. Pilosity of abdomen greyish or slightly yellowish.

21(22) First antennal segment almost cylindrical, long (Fig. 11). Pilosity of antennae black with a considerable admixture of yellow hairs. Tuft of hairs on lower half of occiput at eye margin composed of yellow hairs, with a small admixture of black in males. Outer surface of gonostyles with an excavation before the obliquely truncate apex. Base of hypandrium straight, with no convexity in center (Figs. 5, 41-43). Southern and Central Europe, Ukrainian SSR, southern RSFSR, Crimea, Caucasus, China . . . . . 9. C. virescens F. ♂ and ♀.

22(21) First antennal segment shorter; its outer surface obviously more convex (Fig. 13). Pilosity of antennae black, with no admixture of pale hairs.

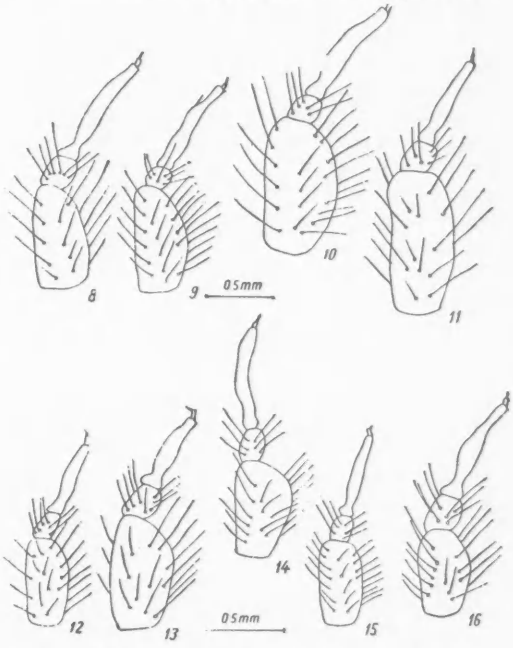


Fig. 8-16. Antennae in dorsal aspect: 8) Conophorus monticola Param.; 9) C. syriacus Param.; 10) C. glaucescens Lw.; 11) C. virescens F.; 12) C. talyshensis, sp. nov.; 13) C. rossicus Param. 14) C. rjabovi Param.; 15) C. caucasicus, sp. nov.; 16) C. nobilis Lw.

** The measurements were made with a micrometer eyepiece.

Tuft on occiput also consisting of black hairs. Gonostyles narrowing evenly to end, with no excavation before apex. Base of hypandrium with central convexity (Figs. 44-46). Asia Minor, south Ukraine, Crimea, Lower Volga, Transcaucasia . . . . . 10. C. rossicus Param. ♂ and ♀.

Conophorus rjabovi Param. (♂, nov.).

This species was described by Paramonov [1929] from a single female from the North Caucasus (Dagestan, Derbent). The male is described for the first time from material from Armenia (village of Martiros, 2/VI/1958]).

♂. Body black, mat, with slight greenish tinge. Proboscis long, extending beyond antennal segment II. Palps longer than half the proboscis. Frons black, slightly lustrous. Hairs on head and antennae black, a few pale hairs only on mentum and occiput. Brush of dense black bristlelike hairs on ventral surface of antennal segment I. Ventral surface of segment II with a small tuft of similar hairs. Dorsal surface of antennal segments I and II with a few black hairs. Antennal segment I rather stout, distinctly bulging on outside (Fig. 14). Lengths of antennal segments I, II and III in the ratio 3:2:3.5; antennal segment III equal in width to II and one-third as wide as I. Ocellar tubercle with black hairs; line of bisection of eyes three times as long as ocellar tubercle. Occiput invested with a few short white and long black hairs. The latter form distinct black tufts at the eye margin below the middle of the occiput, a few light hairs in the upper half of the tufts. Mesonotum clothed with sparse long black hairs; a considerable admixture of white hairs on its fore margin. Surface of mesonotum, and also base of scutellum with a coat of golden scales. Scutellum black, shining, with a few black hairs. Several coarse black bristles in front of wing base. A tuft of dense white and black hairs and bristles located between wing base and humeral callus. Pleura almost bare (only a few pale hairs present). Metapleura with a small tuft of white hairs. Coxae clothed in long white hairs. Legs black, with long, adpressed white hairlike scales. Hairs on fore and mid femora black; hind femora with white hairs, a few black hairs only at apex. Pulvilli well developed extending to tip of claws. Costal margin of wing with usual bristles, with no tubercles. Wings greyish, slightly darkened on fore margin. Vein r_{2+3} almost straight, with only a very slight inflexion towards costa. Vein r_4 issuing from r_5 at an acute angle (Fig. 6). Distance between ends of veins r_4 and r_5 (along line a) almost equal to length of portion of r_5 beyond its fork with r_4. Vein rm located at end of proximal third of discoidal cell. Tegulae pale with white hairs on margin. Halteres pale yellow. Sides of abdomen with long projecting black and shorter white hairs. Abdominal tergites clothed with a coat of golden scales and a few long erect black hairs. Abdominal tergite I with a tuft of white hairs on each side. Abdominal sternites clothed in pale hairs and scales.

Distal constricted part of phallus slightly more than half as long as thickened basal portion (measured along lines a and b). A distinct shoulder on ventral side of distal constricted end of phallus. End of phallus not bent. Apodeme of ejaculator small, projecting slightly beyond gonocoxites. Outer surface of gonostyles with no appreciable excavation before apex. Gonostyles narrowing evenly to a point at apex and slightly bent. Hypandrium in the form of a long crescent (Figs. 26-28).

♀. Fairly similar to male. Differs mainly in the following characteristics. Pilosity of body not pure white, but with slight yellowish tinge. Antennal segment II with no distinct tuft on ventral surface, with only a few black hairs. Body length 4.5-5 mm, wing length 4-4.5 mm.

Holotype: ♀—Dagestan, Derbent, 24/IV/1927 (Ryabov); in collection of Zoological Institute of Academy of Sciences, Ukr. SSR, in Kiev.

New material: 1♂ (allotype), 1♀—Armenia, Martiros village, 2/VI/1958 (V. Zaitsev); 1♀—Azerbaijan, Paraga village, Ordubad District, 25/V/1957 (V. Rikhter).

The male and female of this species were caught by sweeping through meadow vegetation.

Conophorus syriacus Param. (♂, nov.).

This species was described by Paramonov [1929] from a single female from Asia Minor. The male is described for the first time from material from Azerbaijan (10th km on Dymanskaya road, Yardymly District, 18/V/1959).

♂. Body black, mat, with slight greenish tinge. Proboscis long, extending beyond antennal segment II. Palps dark, longer than half proboscis. Frons silvery, slightly lustrous. Antennal pilosity black. Dense brush of black hairs on ventral surface of antennal segment I. Antennal segment II without tuft, only with a few black hairs. Length of antennal segments I, II and III in ratio 3:1:4; antennal segment III with constriction at base, two thirds as wide as II and one fourth as wide as segment I (Fig. 9). Face invested with black and pale hairs; the latter concentrated in lower half of face. Ocellar tubercle with black hairs. Line of bisection of eyes twice as long as ocellar tubercle. Two rows of black hairs on occiput along hind margin of eyes, and extending approximately to the level of the antennal bases; the length of these hairs does not exceed the length of the other pale hairs on the occiput. No tuft of black hairs on occiput. Pilosity of entire thorax pale, silky. Black bristles and hairs located only on hind margin of mesonotum and scutellum. A few coarse black bristles present also in front of wing base. Scutellum black, shining. Surface of mesonotum and scutellum invested with golden adpressed scales. Pleura weakly pilose. Tufts of pale hairs on meso and metapleura. On dorsal mesopleura these are admixed with a few black hairs. Coxae invested with white hairs. Legs black with long pale hairlike scales. Pale hairs on fore femora, and with an admixture

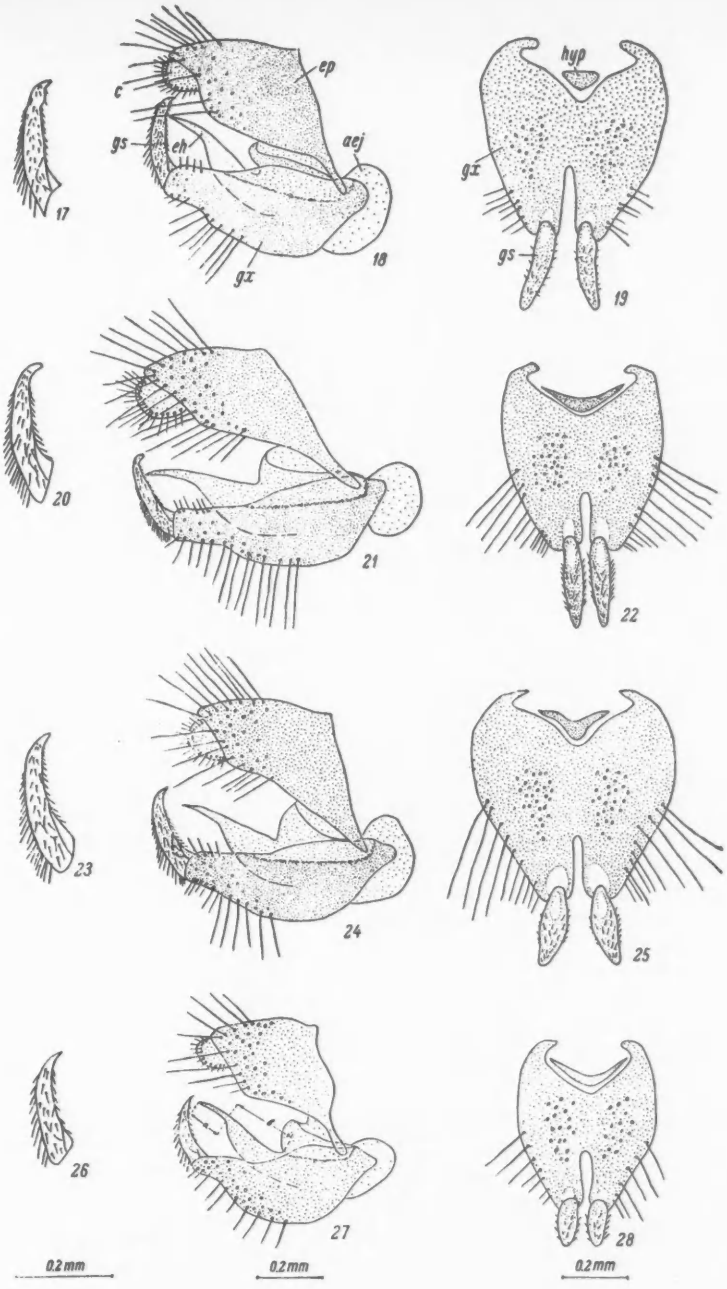


Fig. 17-28. Hypopygia in males: 17-19) Conophorus monticola Param.; 20-22) C. nobilis Lw.; 23-25) C. paraduncus Param.; 26-28) C. rjabovi Param. Fig. 17-46, illustrate the gonostyles, hypopygium (lateral aspect) and gonopods with hypandrium (ventral aspect) for each species: c) ceri ep) epandrium, gs) gonostyles, gx)gonocoxites, ph) phallus, aej) apodeme of ejaculator, hyp) hypandrium.

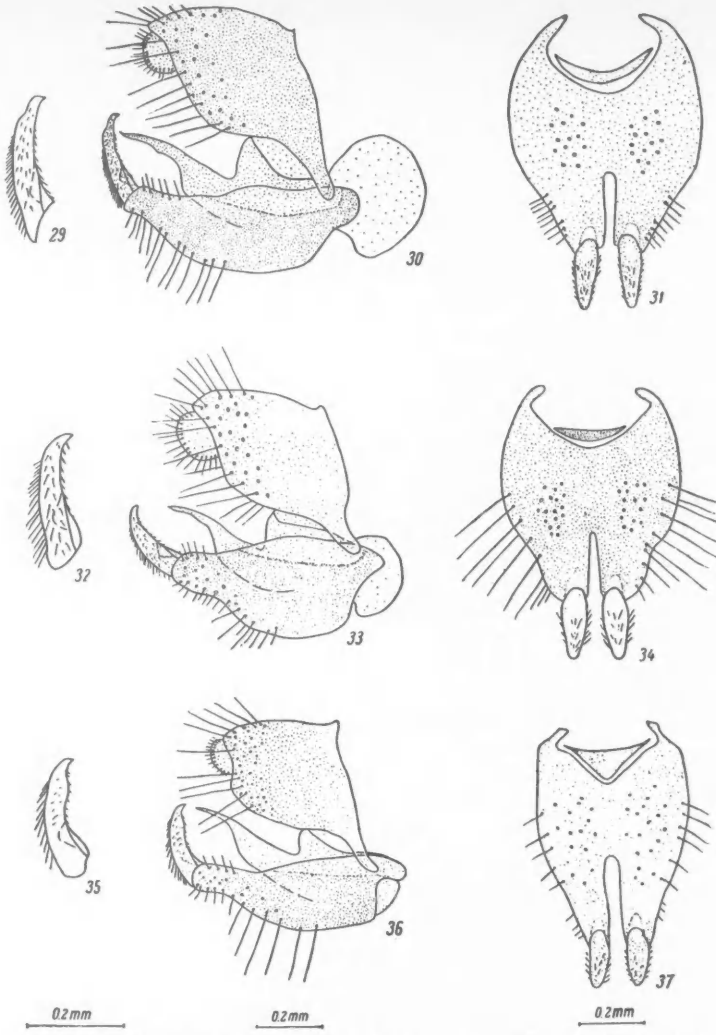


Fig. 29-37. Hypopygia of males; 29-31) Conophorus syriacus Param; 32-34) C. glaucescens Lw.; 35-37) C. talyshensis, sp. nov.

of black on mid and hind femora. Bristles on legs black. Pulvilli well developed, reaching end of claws. Wings (Fig. 4) transparent slightly yellowish only at the very costal margin, which bears the usual bristles. Vein r_{2+3} almost straight, with the bulge towards the fore margin only a little more pronounced than in C. rjabovi Param. Vein r_4 S-shaped and making a right angle with vein r_5. Distance between ends of veins r_4 and r_5 (along line a) almost twice the length of distal part of r_5 beyond base of vein r_4. Vein rm at end of proximal third of discoidal cell. Tegulae pale, with white hairs on margin. Halteres pale. Abdomen with dense pale hairs and a few black bristles on sides. Abdominal surface clothed in pale hairs and golden scales. Long black hairs on hind margin of all tergites with exception of first tergite. Abdominal tergite I invested with exceptionally pale hairs. Sternites with dense pale hairs and scales.

Distal constricted end of phallus subequal in length to basal thickened part. A distinct projection on ventral surface of former. End of phallus slightly upturned. Apodeme of ejaculator large, projecting well beyond gonocoxites. A distinct excavation (Figs. 29-31) before apex on outer surface of gonostyles. Gonostyles blunt at apex. Hypandrium crescentic.

♀. Basically similar to male. Differs in the following characters. Antennal segment I with an admixture of pale hairs. Frons with pale and black hairs and golden scales. Only pale hairs on dorsal mesopleura.

Femora of all legs with pale hairs, only on mid pair a slight admixture of black hairs. Abdominal pilosity the same as in male, only slightly less dense.

Body length 8-9 mm, wing length 7-8 mm.

Holotype: ♀ – Asia Minor, Cilician Taurus; preserved in Becker's collection in Berlin.

New material: Armenia, 2 ♂♂ – Azizbekov village, 3/VI/1958 (V. Zaitsev); Azerbaijan, 3 ♂♂ (including allotype ♂) and 7 ♀♀ – Yardymly District, 10th km on Dymanskaya road, 18/V/1959 (V. Zaitsev); 2 ♀♀ – evirons of St. Kizyl-Burun, Siazan' District, Ata-Chaya Gorge, V/1950 (Trofimov).

Paramonov (1940) wrote about a male from Azerbaijan (Akstafa). He presumed that it could be assigned to the species C. syriacus Param. On a comparison of this specimen with our material Paramonov's supposition was confirmed.

We collected this species on flowers on treeless slopes.

Conophorous talyshensis, sp. nov.

A species closely related to C. caucasicus, sp. n., but much smaller and more darkly colored. In the coloration of the body hairs and in the dark wings it resembles C. luctuosus Lw. (the latter belongs to the group of species with a mat scutellum and which have been recorded so far only from Central Asia). It differs from these two named species also in the structure of the male hypopygium.

♂. Body black, mat, with slight greenish tinge. Proboscis long, extending beyond second antennal segment. Palps reaching center of proboscis. Frons dark, shining. Pilosity of head and antennae black, pale hairs present only on occiput and on lower edge of mouth. Hairs on ventral surface of antennal segment I forming a dense tuft. Lengths of antennal segments I, II and III in ratio 3:1:3.3; antennal segment III with distinct constriction at base, slightly more than half as broad as I (Fig. 12). Line of bisection of eyes three and a half times as long as ocellar tubercle. Occiput clothed in long black and shorter white hairs. A distinct tuft of dense black hairs on lower half of occiput near eye margin. Pilosity of thorax sparse. Mesonotum and scutellum clothed in long black and shorter, sparser white hairs and pale scales. Scutellum black, shining (as in C. virescens F.) Pleura almost bare, with a few black hairs. A strip of black hairs and bristles on upper margin of dorsal mesopleura, this strip extending from wing base to humeral callus. There may be an admixture of a few pale hairs in the upper half of this strip. A small tuft of dark and pale hairs present on metapleura under halteres. Coxae and black legs covered with dark hairs and scales. Pulvilli well developed, reaching end of claws. Wings dark all over, almost black on fore margin and at base. Fore margin of wing with only simple bristles, without tubercles. Vein rm at end of proximal third of discoidal cell (Fig. 3). Tegulae pale, with pale hairs on margin. Halteres yellow, anteroventral half of capitellum more or less heavily darkened. Abdomen with long erect black and shorter white (about half as long) hairs. Surface of tergites clothed with silvery scales. Sides of abdominal tergite I with tufts of white and black hairs. Sternites covered with black hairs and pale scales.

Distal constricted end of phallus half as long as basal thickened part (Figs. 35-37). Projection on ventral surface of constricted end smooth, weak. Apodeme of ejaculator, small, projecting a little beyond base of gonocoxites. A slight thickening on inner surface of gonostyles, a little above the center. Hypandrium broad, in form of an isosceles triangle.

♀. Fairly similar to male, differing only in slightly larger number of pale hairs on body and paler capitellum of haltere.

Body length 6 mm, wing length 5 mm.

Holotype: ♂ – Azerbaijan, Yardymly District, 10th km on Dymanskaya road, 18/V/1959 (V. Zaitsev).

Allotype: ♀ – Azerbaijan, Yardymly District, 10th km on Dymanskaya road, 18/V/1959 (V. Rikhter).

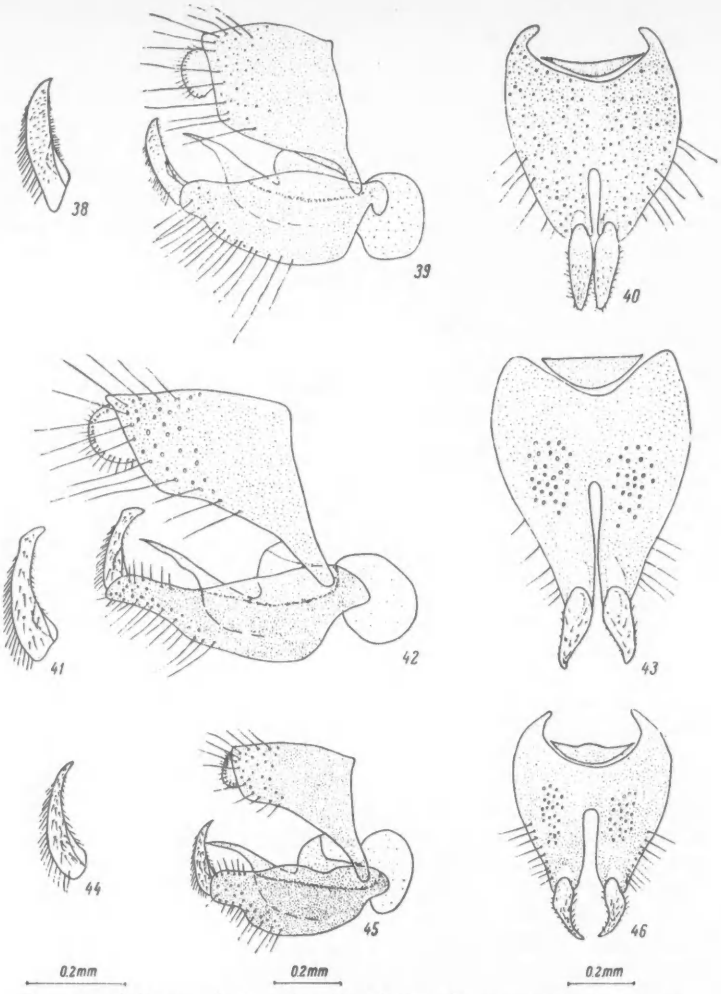
Paratypes: 1 ♂ – Azerbaijan, Lenkoran Region, Astara village, 11/V/1911 (L. Mlokosevich); 2 ♂♂ and 6 ♀♀ – Azerbaijan, Yardymly District, 10th km on Dymanskaya road, 18/V/1959 (V. Rikhter and V. Zaitsev).

Specimens of this species were collected in the shade of a wood, on sunlit spots, on flowers.

Conophorus caucasicus, sp. nov.

A species close to C. talyshensis, sp. nov., and, probably, to C. asiaticus Param. Differences from the former are indicated in the key. It differs from C. asiaticus Param., judging from the description, by the absence of spinules on the fore margin of the wing in the male.

♂. Body black, mat with slight greenish tinge. Proboscis very long, extending well beyond center of antennal segment III. Palps dark, extending halfway along proboscis. Frons dark, slightly shining. Hairs on antennae black, rather dense on ventral surface of segment I, but not forming a distinct tuft. Lengths of antennal segments I, II and III in ratio 2.5:1:3; antennal segment III with a constriction at base (less pronounced than in C. virescens F.), two-thirds as wide as II and one-third as wide as I (Fig. 15). Face covered with black hairs, white hairs present only at lower margin of mouth. Ocellar tubercle with black hairs. Line of bisection of eyes two to two and half times as long as ocellar tubercle. Along hind margin of eyes, to a point roughly level with antennal base, extend several rows of long black hairs almost twice as long as the other pale hairs on the occiput. Large number of short black hairs, forming a distinct tuft, on occiput at hind margin of eyes, a little below level of antennal base. Mesonotum and scutellum covered with long black, shorter yellow hairs and golden scales. Scutellum black, shining. Several coarse black bristles in front of wing base. A strip of black and yellow hairs and bristles extending along upper margin of dorsal mesopleura,



Figs. 38–46. Hypopygia in males: 38–40) Conophorus caucasicus, sp. nov.; 41–43) C. virescens F.; 44–46) C. rossicus Param.

from wing base to humeral callus. Pleura with only a few pale hairs, a small tuft of pale hairs present on metapleura. All coxae with pale hairs, only on mid coxae are there sometimes a few dark hairs. Legs black, femora covered with black hairs and golden scales. Pulvilli well developed. Wings transparent, slightly darkened only at fore margin and at base. Vein r_{2+3} with a distinct bulge towards fore margin of wing. Costal margin of wing with usual bristles, without spinules. Vein rm located at end of first third of discoidal cell (Fig. 2). Tegulae pale with white hairs on margin. Halteres entirely pale yellow. Abdomen clothed in long black hairs and shorter yellor hairs, which become much denser on margins of abdomen, and numerous golden scales. Abdominal tergite I with a tuft of dense yellow hairs on sides. Sternites with yellow hairs, with black hairs, golden scales at end of abdomen.

Distal constricted end of phallus about half as long as thickened basal part. A noticeable bulge present on ventral surface of constricted end. Apodeme of ejaculator large, projecting well beyond base of gonocoxites. Inner surface of gonostyles without thickening. Gonostyles fairly thick over whole length and coming sharply to a point at apex. Hypandrium crescentic (Figs. 38-40).

♀. Similar to male, differing only in following characteristics. Golden scales on frons. Strip extending from wing base to humeral callus consisting mainly of yellow hairs with a very slight admixture of black. All coxae without exception with only pale hairs.

Body length 7-7.5 mm, wing length 6-6.5 mm.

Holotype: ♂ – Armenia, Urts, 1900 m, 29/V/1958 (V. Zaitsev); preserved in Zoological Institute of Academy of Sciences, USSR.

Allotype: ♀ – Armenia, Krasnosel'sk District, Shorzha village, 11/V/1930 (A. Shelkovnikov); preserved in Zoological Institute of Academy of Sciences, Arm. SSR (Erevan).

Paratypes: 2 ♂♂ – Armenia, Krasnosel'sk District, Shorzha village 11/V/1930 (A. Shelkovnikov); 2 ♂♂ and – Armenia, Akhty District, Fontan village, 2/VI/1936 (Ismailov); preserved in Zoological Institute of Academy of Sciences, Arm. SSR.

The holotype was obtained by sweeping through high grass along the bank of a stream.

LITERATURE CITED

S.Ya. Paramonov, "Beiträge zur Monographie einiger Bombyliiden-Gattungen (Diptera)," Zb. prats' Zoolog. Muz. 6, 65-255, I-VI (1929).

S.Ya. Paramonov, "Biology distribution and economic importance of Bombyliidae (Diptera)," [in Ukrainian] Zb. prats' Zoolog. Muz. 23, 51-88 (1939).

S.Ya. Paramonov, "Fam. Bombyliidae (subfamily Bombyliinae), Fauna of the USSR, Diptera [in Russian] 9, Pt. 2, I-IX, 1-414 (1940).

F. van Emden and W. Hennig., "Diptera, 111-122," In: S.L. Tuxen, Taxonomist's Glossary of Genitalia in Insects (Copenhagen, 1956), 1-84.

J.W. Meigen, "Versuch einer neuen Gettungs-Eintheilung der europäischen zweiflügligen Insekten," Illiger's Magaz. f. Ins. 2, 259-281 (1822).

A BRIEF SURVEY OF PARASITIC DIPTERA BELONGING TO THE SUBTRIBE ERNESTIINA IN THE PALEARCTIC FAUNA (DIPTERA, LARVAEVORIDAE), II.*

L. S. Zimin

All-Union Institute for Plant Protection, Leningrad
Translated from Éntomologicheskoe Obozrenie, Vol. 39, No. 3, pp. 725-747, July-September, 1960

In this second part of the review, 7 genera of the subtribe Ernestiina are described. These genera are: Panzeria R. -D., Meriania R. - D., Fausta R. - D., Microerigone, gen. nov., Anameriania, gen. nov., Micronychia Br., Lypha R. - D., and Mimomeriania, gen. nov.

The publication of this second part has been delayed for more than two years due to a variety of causes, but essentially as a result of the need for revising the conception of the limits of the subtribe Ernestiinae. This need for revision has arisen in the light of the work by L.P. Mesnil and the publications of Lindner, relating to the systematics of the family Larvaevoridae. In essence, however, the concept of the subtribe Ernestiinae and its constituent genera is the same in this second article as was given by the author in the first part of the review.

The nature of the setal arrangement on various parts of the adult body is widely used at the present time as a taxonomic criterion among Tachinoid Diptera.

Although this characteristic is very convenient and of considerable value in defining large taxonomic categories, it is a characteristic of doubtful significance in determining phylogenetic relationships. For this reason, the construction of a natural system of classification for the Tachinoid Diptera on this basis alone is hardly justified. In all cases, setal arrangement even at its simplest, exhibits a considerable amount of individual variation and should be supplemented for taxonomic purposes by a consideration of other morphological and biological characteristics, etc.

We further consider that the limits of the large systematic categories (supra-genera, tribes etc.) within the Larvaevorinae have not been fully determined nor, in view of the great complexity of the problem, have the erection of these particular taxonomic categories been fully justified. Whether this particular problem can be satisfactorily resolved by using only setal arrangement as a taxonomic criterion, is something that time alone will show. It would seem, however, that a complete analysis of the various morphological characteristics and their functional significance is needed, in order to construct a taxonomic system based on phylogenetic affinities.

The type specimens of the new species are preserved in the collection of the Zoological Institute, Academy of Sciences.

5. PANZERIA, ROBINEAU-DESVOIDY.

Frons in male only 1/2 - 1/6 as wide as the eye; in the female the frons is equal in width or just slightly narrower than the eye. Third antennal segment as long as, or longer than the second. Basal and third antennal segments approximately equal in size, reddish yellow. Eyes with yellow or brown hairs. Proboscis short; mentum 2-4 times as long as it is broad. Palps cylindrical, slightly thickened at their apices, orange-yellow. Occiput with light-colored hairs, with numerous setules and brown hairs behind the postocular cilia. Orbital setae 2, in female; the ocular - very slender but distinct; the outer seta of vertex in male is similar to the postocular cilia, in the female it is larger. Thorax brownish--black; setae along posterior margin of thorax similar in size, brownish-red; scutum with 3 or 4 dark-colored, longitudinal stripes. Acrostical setae 1 (2) + 3, dorsocentral 3 + 4, post-humeral 2 - 3, intra-alary 3, presutural 1, prealary 1, supra-alary 3 (4); 8 - 10 setae on the margin of scutellum. Discal setae 2 - 6 in number, slender, elongate. Limbs blackish-brown, tarsi of middle and hind limbs in male, chestnut brown, claws and pulvilli longer than fifth tarsal joint; in the female these structures are equal in length or the fifth tarsal joint is longer; the apical joints of the anterior tarsi in the female are to some extent expanded transversely. Deflexion of medial vein is either right-angled or acute-angled, without any branch.

Reddish spots are developed on 3rd and 4th tergites in males; they may be absent in some species and are less frequently developed in females. Sixth tergite of the male forms a narrow hemispherical plate with a convex posterior margin which rises to the dorsal side of the hypopygium; it is separated from tergites 7 and 8 by a deep suture. The length of tergite 6 along its

*The first part of this review was published in "Entom. Obozr", XXXVI 2: 501-537 (1957).

mid-dorsal line is only half that of tergites 7 and 8; it is covered with a pale bloom and gradually tapers laterally so that it does not form a high rib-like strut near spiracle (part I, fig. 2, 2); sclerite formed from sternites 7 and 8, abbreviate conical, not hemispherical, covered with a light-colored bloom. Fifth sternite with small linguiform processes at the side of the median notch; laterally its posterior edge projects beyond the line joining the ends of the processes. Cerci strongly convex at their bases, straightening out towards their apices, which may be pointed or blunt. Coxites short, triangular or linguiform, rounded at their apices, where they bear 2 - 4 very small spinules, which partly project from the lateral surface of the coxites. Sclerite below the 5th sternite very narrow. Lateral processes of 9th tergite small, convex, covering only the anterior part of the coxite bases.

Sixth and seventh tergites in female fused along their edges; dorsally, however, they are separate and represented by two narrow, semilunar sclerites which are evenly convex. Sternites 6 and 7 short and broad; the length of the two together hardly attains that of sternite 5; posterior margin of sixth sternite straight, that of the seventh slightly convex (Part 1, Fig. 2, 7).

Abdominal setae slender, long; discal setae on tergites 3 and 4 are two in number (females) or from four to ten (males); in the latter case they are asymmetrically arranged.

Body length 7.5 - 13 mm.

IDENTIFICATION KEY FOR SPECIES OF GENUS PANZERIA

1 (2) Eyes with rusty brown hairs; cerci in male long, evenly tapered, with blunt apices (Fig. 1, 2); sternites 6 and 7 in female are transverse, with a median longitudinal depression (Fig. 3, 5); the length of these two sternites together just equals that of sternite 5. Scutum with three broad, longitudinal brown stripes present in both sexes. Body length - 9-13 mm ...2. P. vagans Meig.

2 (1) Eyes with pale-yellow hairs; cerci in male pointed at their apices.

3 (4) Apical setae absent from scutellum; pre-apical setae divergent; genae below frontal setae with numerous brown hairs. Frons in male less than half as wide as the eyes. Cerci swordlike (Fig. 1, 1), tergites 6 + 7 in female form two laterally arranged, broad, semilunar sclerites (Fig. 3, 6); third antennal segment usually brown. Body length 7.5 - 9.5 mm... 3. P. nielseni Villen.

4 (3) Scutellum with short intersecting apical setae, genae below frontal setae without hairs; frons in male only 1/6 as broad as the eyes. Cerci broadly swordlike (Fig. 1, 3), tergites 6 + 7 narrow in female, strip-like; third antennal segment reddish yellow at the base. Body length 7.5 - 13 mm. ..... 1. P. rudis Fall.

1. Panzeria rudis Fallén

Male: Frons only 1/6 as wide as the eyes; genae 1/3 as wide as eyes and a little wider than the third antennal segment, rarely equal to the latter. Eyes with pale-yellow hairs. Antennae small, 3rd antennal segment hardly longer than 2nd; antennal segments a little more than 1 1/2 times as long as broad; mentum twice as long as broad. The genae and median portion of face covered with yellowish or white bloom. First antennal segments and often the basal half of the third segments rusty red, not infrequently the third antennal segment is completely brown and the second segment more or less so. Ocelli and setae on vertex barely discernible because of the density of the ocular cilia. Scutum with 3 broad, longitudinal stripes. Scutellum reddish-yellow at the summit. Post-humeral setae 2; apical setae of scutellum intersecting. Angle of median vein acute; apical sector m, from its point of curvature to the posterior transverse vein, is not quite half as long as the short piece of the median vein, lying between the posterior and middle transverse veins. Limbs brown. Abdomen ovoid, brown, usually with round reddish-yellow spots at the side of the third and fourth or the first tergite. Abdomen covered with a dense greyish-white bloom. Body length 7.5 - 13 mm.

Female: Width of frons equal to or slightly less than the width of the eye. Width of third and fourth segments of the anterior tarsi is often greater than their length. Abdomen with greyish-white bloom. Body length 7.5-13mm.

This is a widely distributed species. It is known from the Leningrad region of the European USSR to Caucasia; it occurs in Central Asia (Gissarskii Mts.); in the Baikal and Amur regions and in Ussuri Land.**

2. Panzeria vagans Meigen

Male: Frons only 1/5 - 1/6 as wide as the eyes. Frontal strip reddish-brown, tapering in front of the ocular triangle. In profile the head is trapeziform; frons and ventral margin of face project forwards almost to the same extent. The width of the gena barely exceeds that of the 3rd antennal segment; height of subgenae only half that of the vertical diameter of the eye. Antennae short, second and third segments equal in length; the length/breadth ratio of 3rd segment is 1:0.7. Arista thickened at the base. Proboscis short, with large labellum; mentum four times as long as broad. Palps orange-yellow, with numerous brown hairs. Head blackish-brown, face greyish-yellow, occiput uniformly convex. Orbits, genae and face covered with a silky glossy and white bloom, occiput with a scanty greyish-white bloom. Setae of frons, together with ocular, internal and external setae of vertex long and slender. Eyes with brown but no yellow hairs as in so many members of this tribe. The bloom of the subgenae is barely noticeable. Occiput with long yellowish-grey

**Ussuri Land=Maritime Territory

hairs, subgenae with long brown hairs. Thorax black; scutellum, except for a brown oval at the base, reddish-yellow; scutum with three dark, longitudinal stripes, separated by narrow intervals of greyish-white bloom; middle stripe wider than the two outer ones. Arrangement of thoracic setae as follows: Acrostical 3 + 3, dorso-central 3 + 4, intra-alary 0 + 3, post-humeral 2, presutural 1, pre-alary 1 (2), supra-alary 4, sternopleural 2 + 1. On the scutellum: Apical seta just a little shorter than the subapical setae which intersect each other, pre-apical (1), lateral (2), basal (1); the prebasal are long and hair-like; discals 2 - 3 pairs, slightly curved, slender, elongate. Wings greyish, bend of median vein acute, without any branch; median sector from its angle to posterior transverse is less than half as long as the piece of the median vein between the middle and posterior transverse veins. Cell R_5 open, costal spine not developed. Vein r_{4+5} has 4 - 5 erect, setiform hairs at its base; squammae parchment-like, with white bloom and pale yellow margins; halteres dark-yellow. Limbs brown, partly dark-brown, pulvilli and claws somewhat longer than 5th tarsal joint. Abdomen brownish-black, glossy; abdominal tergites 3 and 4 with reddish-yellow spots laterally. Surface of tergites, except for the black strip along their posterior margins, with greyish-white, silky bloom. Tergites 6 and 7 clearly separated from 8th tergite and bearing long brown hairs. Cerci longer than coxites, elongately triangular in form and curved ventrally, with blunt apices (Fig. 1, 2); coxites wedge-shaped, with 1 - 2 small curved toothlets at their apices. Sternite 5 cleft into two parts over 3/5 of its length; at the side of the cleft occur short, broadly rounded processes.

Female. Breadth of frons is 4/5 that of the eye; frontal strip somewhat broader than the orbit, orbital setae 2, setae on vertex and ocular setae stouter and longer than those of frons. Antennal segments 1, 2, and base of 3, reddish-yellow. Abdomen broadly ovoid. Sternites (Fig. 3, 5) of 6th and 7th segments almost equal in length, their posterior edges convex and with a longitudinal depression in the middle. Tergites 6 and 7 have characteristic, narrow, semi-lunar sclerites which are lateral in position. Segments of anterior tarsus expanded: length of these segments slightly greater than their breadth. Body length 9 - 13 mm.

This species is not encountered often and is known mainly from individuals collected as follows: Krasnoyarsk region: 1 m. – Uzun-zhul, tributary of R.

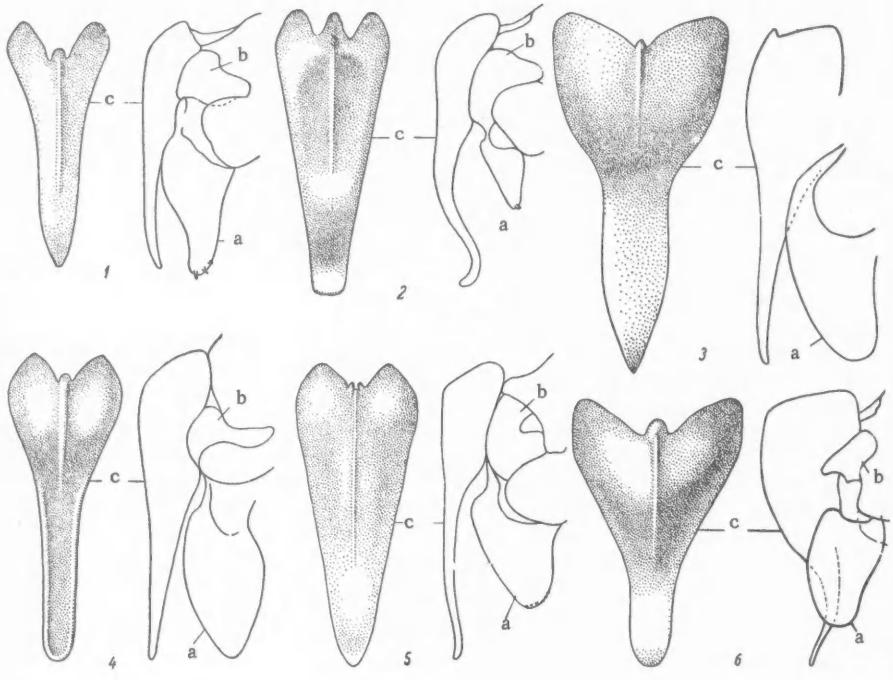


Fig. 1. Cerci and coxites of Ernestiina males in posterior and lateral view (originals) 1) Panzeria nielseni Villen; 2) Panzeria vagans Meig.; 3) Panzeria rudis Fall.; 4) Meriania sulciforceps, sp. nov.; 5) Meriania histrio Meig.; 6) Microerigone sima sp. nov. a) distal end of coxite; b) base of coxite; c) cercus.

Abakana, 8 June 1897 (Wagner); 1 f.—Dzhezen Mts., near Abakana, 7 July 1897 (Wagner); 1 m.—Berezovii, tributary of R. Abakana, 12 June 1912 (Sushkin); 1 f.—upper reaches of R. Mana, 24 June 1912 (Tugarinov); 1 m.-Krasnoyarsk, 23 June 1953 (Kolomnets); 2 f.—R. Kyzas, 9 June 1912 (Sushkin, Redikortsev); 1 m.—Cheposh, Gorno-Altai region, 12 May 1911 (Yurganova); 1 m.—Khuzino—Irkutsk region, 19 June 1949 (Kolomnets); 1 m.—Irkutsk, 5 June 1905 (Yurinskii); 1 f.—Sikhotealinskii Nature Reserve, Ussuri land 12 June 1945 (Nesmerchuk); 1 f.- Luga. Leningrad region, 29 June 1925 (Shtakelberg); 1 m.-1 f.—habitat not known.

3. Panzeria nielseni Villeneuve.

Male. Frons less than half the width of the eye; face almost perpendicular in profile; ventral margin of face projects forwards to same length as frons. Gena less than half the width of the eye and a little narrower than third antennal segment. Antennae rusty-brown with rust-colored patch at the apex of the second segment. Third antennal segment slightly longer than the second, the former is expanded somewhat at its distal end; the ratio of the lengths of these two segments is 1 : 0.8. Length of mentum is 3 times its breadth; palps pale--yellow. Eyes with light-yellow hairs. Scutum with 3 broad, longitudinal, brown stripes separated from one another by broad intervals of greyish-white bloom. Humeral setae 5, of which the 2 anterior ones are small. The 3 distal segments of the anterior tarsi in the female are slightly expanded, so that they are almost as broad as long. The bend in the median vein is just slightly less than a right angle; distance from angle to posterior transverse vein is less than half the length of the sector m from the median transverse vein to the posterior transverse. At the base of r_{4+5} with 4 -5 there are a few erect setules; squammae yellowish-white. The upper surface of the abdomen is completely covered with greyish-white bloom. Cerci and coxites are as shown in Fig. 1, 1. Tergite 1 + 2 with 2 median marginal setae; 1 - 2 pairs of discal setae on tergites 3 and 4. Terminal abdominal segment of female as in Fig. 3, 6. Body length 7.5 - 9.5 mm.

A comparatively rare species, known from Central Northern Europe, the mountains of Southern Europe and from Western Siberia.

6. MERIANA ROBINEAU-DESVOIDY

Frons in male narrower than eye, in female equal in width; antero-ventral edge of face projects slightly forwards. Genal width equal to transverse diameter of 3rd antennal segment. Palps long, barely thickened at the apex. Eyes with long, dense, brown hairs. Frontal setae 3, with occasionally 1 - 2 supplementary setae; 2 pairs of orbital setae in female; ocular and vertical setae only found in female, in the male they are represented by slender hairs. Thorax in male with 3 broad brown stripes; in the female the middle stripe is divided into 2 or 3 narrow stripes. Genae and notum with brown hairs; in some species the pleurae have yellow hairs mixed with the brown. Pronotum narrow, without hairs. Acrostichal setae 1 (2, 3) + 1 (2, 3), dorsocentral 3 + 4, intra-alary 0 + 3, post-humeral 2 (3), humeral 5, presutural 1, pre-alary 1, supra-alary 4, post-alary 2, sternopleural 2 + 1. On the scutellum occur the following setae: Apical 2 (one may be absent), pre-apical 1, lateral 2 (3), basal 1, discal 1 - 4 pairs, all of which are short and intersecting. Squammae white or yellowish. Halteres yellow. Wings greyish, with brownish markings near r - m, vein m with an acute- or right--angled bend near its apex; the branch at the bend is absent or very short; the external costal spine is no longer than the transverse costal vein. Limbs brown; median and posterior tibiae brownish; segments of anterior tarsi strongly expanded in the male; claws of anterior tarsi in male usually a little longer than the 5th tarsal joint. Abdomen relatively broad, sternites wide. In the male, 6th sternite is from 1/2 - 1/3 as long as the hypopygium of the subsequent segments (tergites 7 & 8), from which it is separated by a membrane (Part 1, Fig. 2, 1); lateral out-growths of 9th segment glossy, slightly bent, rounded; cerci of male long, narrow and expanded into a triangle at the base; coxites linguiform, with tapered ends and convex lateral margins; no teeth at the apex; 5th sternite in male broad and separated into 2 halves over 1/3 of its length by a narrow cleft; hinder margin of cleft with short, stout, rounded projections. Sternites 6 and 7 in female in the form of transversely elongated plates; their total length is barely that of the 5th sternite; tergites 6 and 7 with a longitudinal line down the middle; tergites 3 and 4 with one or two pairs of discal and marginal setae. Abdomen with long hairs. In some species the ventral surface is more or less covered with yellow or rust-colored hairs.

IDENTIFICATION KEY FOR SPECIES OF THE GENUS MERIANA

1 (2) Long greyish-yellow hairs densely covering the ventral surface of the abdomen, the sides and anterior edges of tergites 3 and 4, the greater portion of the pleura, genae, occiput and invariably the lower surfaces of the femora and coxae. Light-colored bloom present on tergites 3 and 4 in both sexes; this bloom covers about 1/4 to 1/3 the length of the tergites. On tergite 5 the bloom is confined to a small patch in the middle of the anterior margin or a similar patch occurs together with stripes at the side of the anterior margin; male cerci broad, strap-like, gradually tapering towards their apices, which are cut off short; the sides of the cerci in the

distal half are bent slightly upwards; coxites short, broadly curvedat the ends. . . . . 4. M. flavovillosa, sp. n.

2 (1) Abdomen with black hairs ventrally; these are occasionally mixed with light-colored hairs. If light-colored hairs occur, then there are strips of light-colored bloom on tergites 3, 4 and 5; these strips occupy not less than half the length of the tergites. Cerci in male very narrow distally.

3 (6) Orbital setae present in females.

4 (5) Dorsal surface of tergites 3, 4 and 5 completely covered with light-colored bloom, which forms iridescent patches. Acrostical setae 3 (4) + 3, discal setae near to posterior margin of scutum 6 - 5. Tergite 6 with several rows of setae and hairs; sternite 7 with a convex posterior margin, broad, without any median depression as in sternite 6 (Fig. 6, 1, part 1) . . . . . 3. M. histrio Meig.

5 (4) Light-colored bloom on tergites 3, 4 and 5 extends over more than 1/2 - 2/3 of their length; posterior margin of same segments glossy black; acrostical segments glossy black; acrostical setae 1 (2) + 1 (2), discal setae on scutellum usually restricted to a single pair. Sixth tergite with a single row of setae, narrow; sternite 7 with a shallow notch in the middle of its posterior margin and with a median, longitudinal depression, as on sternite 6 (Fig. 5, 6) . . . . . .2. M. puparum puparum F.

6 (3) Orbital setae absent from males.

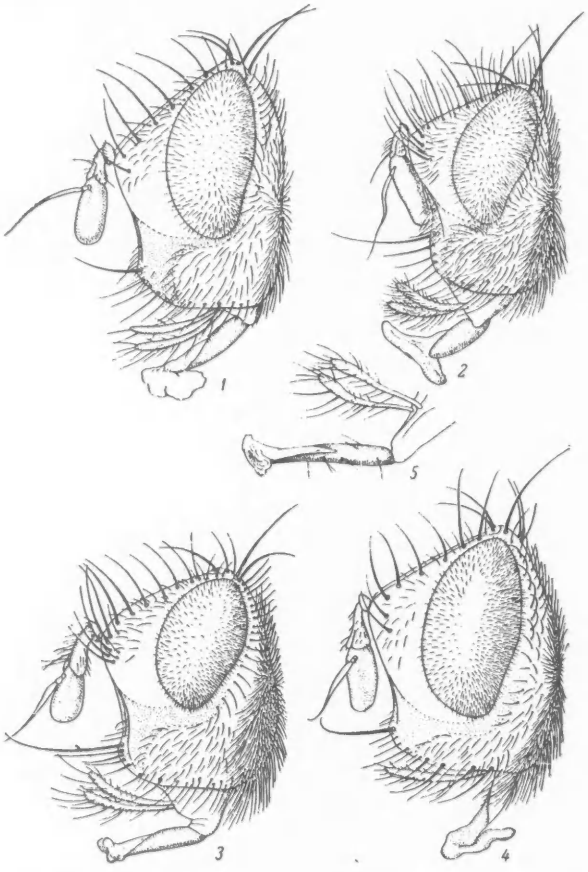


Fig. 2. Drawings of heads of male Ernestiina (lateral view) and proboscis of female (Original) 1) Microerigone sima, sp. nov.; 2) Anameriania albomicans, sp. nov.; 3) Fausta nemorum Meig.; 4) Mimomeriania elongatula, sp. nov.; 5) proboscis of female Fausta bey-beinkoi, sp. nov.

7 (8) Light-colored bloom on dorsal surface of the abdomen covers the whole of tergites 3, 4 and 5, and forms iridescent patches. Cerci elongately triangular, gradually tapering towards the apex (Fig. 1, 5); frons half as wide as the eyes . . . . . 3. M. histrio Meig.

8 (7) Light-colored bloom covers 1/2 to 2/3 length of tergites 3 - 5, posterior margin brownish-black; cerci triangular at the base, their distal 2/3 is in the form of a narrow almost parallel-sided strip; frons 1/3 - 1/5 as wide as the eyes.

9(10) Cerci with deep, broad, longitudinal furrows on their dorsal surfaces, where they taper towards the apex (Fig. 1, 4); acrostical setae 2 + 3, discal setae close to posterior margin of scutellum 8, genae and subgenae with black stripes . . . . . 1. M. sulciforceps, sp. nov.

10(9) Dorsal surface of tapered portion of cerci flat, glossy, without furrows; acrostical setae 1 (3)+ + 1 (3); usually one pair of discal setae on scutellum.

11 (12) Black hairs present on the dorsal margin of the genae; light-colored hairs may occur proximally on the ventral surface of the abdomen; fifth tergite completely black dorsally; there are patches of red at the sides of tergites 3 and 4— —these are small and less than half as wide as the tergites themselves. . . . . 1. M. puparum melanopyga ssp. nov.

12 (11) Genae and subgenae with pale, slender hairs, sometimes with a few black stripes low down on the subgenae.

13 (14) Acrostical setae 3 + 3; golden yellow hairs cover most of the ventral surface of the abdomen and also the pleura and femora; tergite 5 completely black. . . . . 1. M. puparum tadzhicorum (nov.)

14 (13) Acrostical setae 1(2)+ 1; abdomen and pleura covered mainly with brown hairs, among are a few yellow and rusty-red ones; femora with brown hairs; tergite 5 with reddish markings laterally . . . . . 1. M. puparum puparum F.

1. Meriania sulciforceps, sp. nov

Male. Frons 1/4 the width of the eyes; orbits and genae with white bloom; third antennal segment as long as the second; antennae brown, with a reddish brown tip to the second antennal segment; genae and orbits with short black hairs; subgenae with long brown hairs, mixed with a few yellowish grey ones ventrally. Thorax blackish brown; scutellum reddish brown at the top, notum with three broad black stripes, which are separated anteriorly by narrow strips of grey bloom. Acrostical setae 2 + 3. Pleura with brown hairs, which on the hypopleura and sternopleura are rusty red at tip. Discal setae on scutellum 4, hardly distinguishable as regards length and breadth from simple hairs. Bend in vein in acute--angled, branch absent. Abdomen brownish black; tergites 3 and 4 with lateral reddish patches on the front half of the tergites. Tergites 3, 4 and 5 are covered by greyish white bloom over two thirds of their length; posterior edges of tergites glossy black. There are two pairs of discal setae on tergites 3 and 4. Basal third of cerci triangular with their distal parts tapered but rounded at the end; a longitudinal depression occurs on the dorsal surface of the cerci (Fig. 1, 4). Coxites a little broader than in M. puparum. Body length 12.5 mm.

Known from a single male specimen (holotype) from the Yakovlevka region of Ussuri land, May 2, 1926 (D'yakonov and Filipev).

2. Meriania puparum Fabricius

Male. Frons about $\frac{1}{3}$ - $\frac{1}{4}$ the width of the eyes. The length/breadth ratios of antennal segments 2 and 3 are 1:1 and 4:5 respectively; the first two antennal segments are reddish brown, the third is brown and very slightly thickened at its apex, its length is about 1 1/2 times its width. Palps reddish yellow. Orbits and genae with glistening, greyish white bloom, subgenae and occiput with dull grey bloom. There are yellowish hairs on the occiput and long, slender black and yellow hairs on the subgenae. Behind the angular vibrissae are found short setules, arranged in 2-3 rows. Thorax brown, with the posterior areas of the pleura mainly yellowish; scutum with 3 broad, brownish black, longitudinal stripes separated from one another by narrow stripes of grey bloom. The medium stripe is sharply interrupted posteriorly and gives off slender, brown streaks in the direction of the scutellum. Acrostical setae 1 (2) + 1; apical setae of scutellum half as long as the pre-apical; usually 1 pair of discal setae occur; scutellum brownish red, brown at the base. Bend in vein is acute-angled, sometimes a short branch is present. Claws equal in length to 5th tarsal joint. Lateral portion of tergites 3, 4 and 5 yellowish red; light-grey bloom covers two thirds of the tergites in question. Abdomen with long yellowish hairs on its ventral surface. Tergite 1 + 2 with pairs of slender marginal setae; tergite 3 and 4 with 1-2 pairs of discal setae. Sternite 5 with a narrow median notch which divides it over half its length; the posterior lateral portions project as rounded processes. Cerci as shown in Fig. 5, 3.

In the female the frontal width equals that of the eyes, the first two antennal segments are reddish yellow; the reddish markings on the lateral portions of the abdomen are poorly developed; segments of anterior tarsi strongly expanded (Fig. 3, 3). Sternites 6 and 7 much wider than long, each with a median longitudinal depression (Fig. 5, 6); sternite 7 with a shallow indenta-

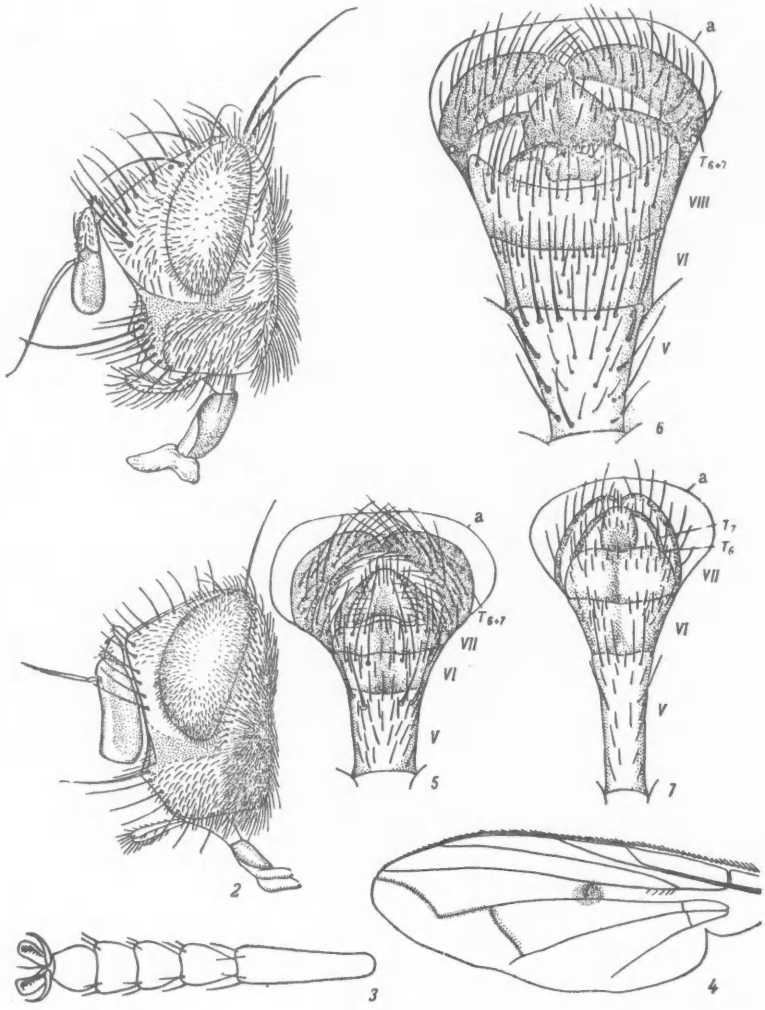


Fig. 3. Morphological details shown by members of the Ernestiinae (Originals) 1) head of female Meriania histrio Meig (lateral view); 2) ditto of male Micronychia ruficauda Zett; 3) anterior tarsus of female Meriania puparum puparum F; 4) wing of Micronychia ruficauda Zett; 5) terminal abdominal segment of female Panzeria vagans Meig (ventral view); 6) ditto of Panzeria nielseni Villen; 7) ditto of Microerigone sima sp. nov.; 9) posterior margin of tergite 5; T6+7 - fused sixth and seventh tergites; T6 T7 - distinct sixth and seventh tergites; V, VI, VII and VIII sternites 5 to 8.

tion in the middle of its posterior margin, reddish brown, glossy. Sclerites comprising tergites 6 and 7 with a single row of setae along their posterior edges. Body length 11 - 12.5 mm.

This species, according to the material at the authors disposal, is represented by 3 subspecies (in the U.S.S.R.). M. puparum puparum F. is widely distributed in Central Europe and Siberia, to the east as far as Irkutsk; M. puparum melanopyga ssp. nov. is found in Northern Mongolia and Ussuri Land (holotype from Ussuri Land and M. puparum tadzhicorum ssp. nov. inhabits Tadzhikistan (Gissarskii Range). The characteristic differences between these three subspecies are shown in the identification key.

3. Meriania histrio Meigen

Male. Frons half as wide as the eyes. Genae, at their narrowest part, half the diameter of the eyes and barely as wide as the third antennal segment, with black hairs, as have the subgenae. Antennae brownish black, tip of second segment brownish red. Scutum with 3 dark-colored, longitudinal stripes, of which the middle one is divided posteriorly by a broad strip of light-colored bloom, thus giving two narrower stripes. Hairs on thorax are entirely brown; acrostical setae 3+3; apical setae of scutellum absent; 2 pairs of discal setae occur on scutellum. Bend in vein m is acute-angled, branch absent or very short (its length does not exceed 1/8-1/10 that of the previous branch of the median vein). Abdomen brown with reddish, indistinct patches on the lateral portions of tergites 3 and 4. Tergite 5 brown. Pale grey bloom completely covers the upper surface of the abdomen also the ventral surface, where it forms iridescent patches. Discal setae on tergites 3 and 4 number from 2 to 6 -- 8 pairs on each tergite. Cerci elongately cylindrical, gradually tapering towards the apex (Fig. 1, 5); they are significantly wider than in M. puparum. Coxites similar in shape to those of M. puparum; at the distal end they bear 3-4 spinules externally.

Female. Breadth of frons is equal to that of the eyes; genae (Fig. 3, 1) and subgenae with black hairs; coloration of scutum as in male; acrostical setae 3+3, intra-alary often absent, apical setae of scutellum either absent or developed only as slender hairs. Red patches at the side of the abdomen absent; sternites 6 and 7 without a median longitudinal depression, posterior margin of 7th convex. Body length 9-12 mm.

The species is known to the author by 2 males and 6 females caught near Moscow (Sokol'nik), Lugansk and from the Crimea (Alushta).

4. Meriania flavovillosa, sp. nov.

Male. Frons tapers sharply in front of the ocular triangle where its breadth is slightly narrower than that of the third antennal segment; The claret-colored frontal strip is strong expanded anteriorly in front of the ocular triangle. Frons projects beyond the epistome, it is slightly convex and lies in almost the same plane as the face; occiput slightly convex dorsally and strongly so ventrally; genae almost twice as broad as the third antennal segment; height of peristome slightly more than half that of the vertical diameter of the eye. Head blackish brown, face rusty brown with a darker central area, median area claret; sometimes with a rusty red, anterior margin. Orbits and genae with greyish white bloom, sometimes yellowish in the region of the anterior frontal setae; face with grey bloom, peristome and occiput with pale grey bloom and pale yellow hairs which in places are almost grey. Frons, genae and peristome, with long, slender, pale-yellow hairs, which are denser on the peristome, where there are no setae along the ventral margin; orbits often with mixed brown and light-colored hairs. Ocular setae extremely similar to hairs of ocular triangle; eyes with long brownish hairs; post-ocular cilia very long and hair-like, with their tips bend forwards; cilia of vertex similar to the post-ocular. Frontal setae very slender, absent from posterior third of frons; anterior frontal setae project as far as the end of the second antennal segment, these latter setae are usually arranged in 2-3 irregular rows. Vibrissae tall, raised above the edge of the epistome. Antennae blackish brown, short, third segment with parallel sides and broadly rounded at its apex, its length is the same as that of the second segment or slightly more, apex of first segment rusty red; arista brownish, elongated, thickened over its proximal half, distally it is slender. Proboscis short, length of mentum a little less than the combined lengths of the 2nd and 3rd antennal segments and only slightly greater than twice its own breadth; sucking lobes (labellum) very large; palps a little longer than mentum, brownish, slightly thickened and covered with dense black hairs at the tip and long, slender pale yellow hairs along their ventral sides. Thorax blackish brown; scutellum, apart from a transverse strip across to base, and the anterior half of the post-alary prominences yellowish or rusty brown; scutum with brown and grey bloom, with 3 longitudinal dark-colored stripes, very indistinctly delimited; humeral prominences and pleura with scanty grey bloom. Hairs on thorax long, slender and bright-yellow or greyish-yellow with a very slight admixture of black hairs. Thoracic setae as follows: acrostical 1(2) + 2(1), dorsocentral 2(3) + 4, intra-alary 0 + 3, presutural 1, humeral 4-5, posthumeral 1-2, supra-alary 4-5 (sometimes certain of these are duplicated with a consequent increase in number of 1-2 setae), post-alary 2, sternopleural 1 (0 + 1), pteropleural 2. On the scutellum the apical setae are various (they may be absent or reduced to 1), the subapical, 2 lateral and basal are almost of equal length and slightly longer than the apical; pre-apical somewhat shorter than the apical. All the setae from different parts of the thorax are of different lengths, very slender and hairlike. Hairs

of peritreme around thoracic spiracles yellow or reddish yellow. Wings light grey, veins brownish, dark yellow at the base; rm with a smoky patch; cells at base and on anterior edge of wing faintly darkened, most of the longitudinal veins with smoky outlines. Median vein with acute-angled bend and usually with a short appendage; length of median vein from angle to m-cu 2-2.5 greater than distance from angle to posterior margin of wing; sector of median vein from m-cu to rm 2-1.7 times longer than distance from angle to posterior margin of median vein; cell R_5 open; r_{4+5} with 3-6 very slender cilia at its base; no spinules on fifth sector of costal vein and spinules largely absent from fourth sector. Costal spine not developed; squammae dark-yellow over most of their surface; internal edge of squammae brownish; halteres yellow. Limbs blackish brown, tibae brownish or, in the case of the posterior and middle tibae, brownish yellow; tarsi reddish brown over the whole of their ventral surfaces and along the mid-dorsal line; claws brown with black tips; the ventral surface of all three pairs of femora, together with the posterior edge of the anterior and middle femora, with greyish yellow hairs. Claws of anterior tarsi equal in length to that of the two most distal tarsal joints;fourth tarsal joint forms a short triangle, its length is equal to that of the preceding joint or slightly less. Anterior tibiae with 2 posterior setae, middle tibiae with 3 antero--dorsal and 2 internal setae, of which the upper is considerably smaller than the lower. Abdomen brownish black; postero-lateral edges of tergite 2, lateral portions of tergites 3 and 4 and antero-lateral portions of tergite 5 are reddish yellow; the black stripe on tergites 3 and 4 is expanded posteriorly and forms a trapeziform patch, of which the front edge is 1/3 the bredth of the tergite and the hinder edge 3/5 its breadth. The reddish yellow coloration on tergites 2, 3 and 4 extends to the lateral parts of the ventral surface; the posterior edge of these same segments have a narrow yellow posterior margin to their sternites. Tergites 3 and 4 with a median strip of dense white bloom which occupies about 1/3 of their length and half their breadth. Fifth tergite with a continuous strip of similar bloom over the anterior 2/5 of its length or with a patch of bloom in the middle of its front edge. Abdomen with slender, erect, pale yellow hairs and with black or mixed black and light colored hairs on the posterior sections of the dorsal surfaces of tergites 3, 4 and 5 and the ventral surface of segment 5. The hairs on the ventral surface of the abdomen are longer than the tergites from which they arise; those on the dorsal surface are short. Tergite 2 with 2 median marginal setae and 2-3 lateral setae; tergite 3 with 4(2) median marginal setae, one or two pairs of median discal setae and, on each side 2-5 lateral marginal setae; tergite 4 with one or two pairs of median discal setae and marginal rows of 15-20 setae; tergite 5 as long as tergite 4 or slightly shorter, its width at the base is 2.3-- 3 times greater than its length, posterior margin of tergite with rows of marginal setae and 2(1) rows of discal setae, distributed over the posterior half of the segment; sometimes there is a third incomplete row of setae on the anterior half of the tergite. Sternites broad, without setae, shorter than they are wide; a membrane is usually visible around sternite 4; sternite 5 has a short triangular notch penetrating to 1/3 or 1/4 of length, median process of this sternite very short, slender and broadly rounded; the width of sternite 5 is almost twice its length. Tergite 6 separated from the fused tergites 7 and 8 by a deep furrow, the former tergite is only half as long as the latter; tergite 9 equal in length with tergite 6. Cerci long and strip-like, slightly convex with a triangular, divergent base, apical portion curved ventrally; lateral portions of distal half bent slightly upwards; over the whole of their length the cerci are delicately ribbed and covered with long black hairs which are scantily arranged and somewhat shorter in the distal half. Tergites of hypopygium with very long, slender and setiform hairs, some of which are black, others paler. Lateral outgrowths of tergite 9 glossy, black or brown, covering the bases of the coxites; their distal parts are short and broadly rounded, very slightly longer than broad, without toothlets at the apex.

Female. Distinguished from the male by greater width of frons, which is 0.7 times the width of the eyes; frontal strip 1.6 times as wide as the orbit; there are 2 external orbital setae and the prevertical setae are considerably more slender than the orbital; the setae on the inner side of the vertex are very long and stout; those on the outer side of the vertex are less than half as long as the internal vertical setae and barely as long as the post--ocular setae; ocular setae large; postocular cilia long somewhat stouter than those in male, with their ends pointing slightly forwards. The dark stripes in the scutum are more sharply separated than in male. Joints of anterior tarsi strongly flattened; width of third joint is 1½ times that of fourth joint and almost twice the length; length of claw a little less than that of the almost round fifth joint. Reddish markings on postero--lateral edges of tergite 2 and at the front of the lateral portions of tergite 3, very small; abdomen broadly ovoid very glossy; white bloom forms transverse strips along the front edge of tergites 3 and 4, width of strips about 1/4 the length of the tergite; on tergite 5 the bloom forms small spots in the middle of the anterior edge of the tergite. Length of sternite 5 almost equal to combined lengths of tergites 6 and 7; width of sternites 6 and 7 is one and a half times their length; tergite 6 joined to tergite 7 along its posterior margin; the compound segment formed in this way has 2 narrow, curved strips running down its middle; each of these stripes is glossy anteriorly and posteriorly is covered with bifid hairs and slender setae giving it a dull appearance. The setae in the female are relatively coarser and larger than those of male.

This species is described from 6 males and 2 females from China and kindly sent to me by colleagues in the Entomological Institute, Chinese People's Republic at Pekin: 4 males, 1 female, Shanghai, 2 April 1933. (A. Savio) (Holotype - male and allotype- female); 1 male -6 April 1933 (A. Savio); 1 female, Shanghai 15 April 1930 (O. Piel); 1 male - 5 April 1933 (O. Piel); The holotype and allotype are preserved in the Entomological Institute Pekin; 1 male, 1 female collected by O. Piel - - in the Zoological Institute, Academy of Sciences, U.S.S.R. at Leningrad.

7. FAUSTA ROBINEAU-DESVOIDY

Breadth of frons in male equals 1/3 - 5/9 and in female 1/1 - 5/6 breadth of eyes; antennae small, their tips do not reach the ventral edge of the eyes; third antennal segment slightly expanded at the apex, its length is the same as that of the second segment or slightly more and twice its width. Genae less than half as wide as the eyes and 1.8 times as wide as the third antennal segment. Occiput markedly convex ventrally. Proboscis with small sucking lobe (labellum); mentum long and slender or truncate (length/breadth ratio 3: 7); palps yellow, sometimes they are brownish at the base, expanded at tip. Ocular setae of the vertex is well developed in both sexes; external setae of vertex always large in female, often absent in male, frontal setae 3-5, in the males there are often 2-4 additional frontal setae forming a second row; pre-vertical and orbital setae only present in female, two on each side; above angular vibrissae are one to four long setae and a few short hairs. Eyes with light colored hairs. Orbits [Fig. 2, 3] with a few scanty stiff brown hairs, subgenae with long, more densely packed hairs. Occiput behind eyes with one to two rows of slender, short setules and hairs, farther back still there is a dense covering of long, light colored yellowish-grey hairs. Genae naked. Head blackish-brown. Posterior margin of scutellum often

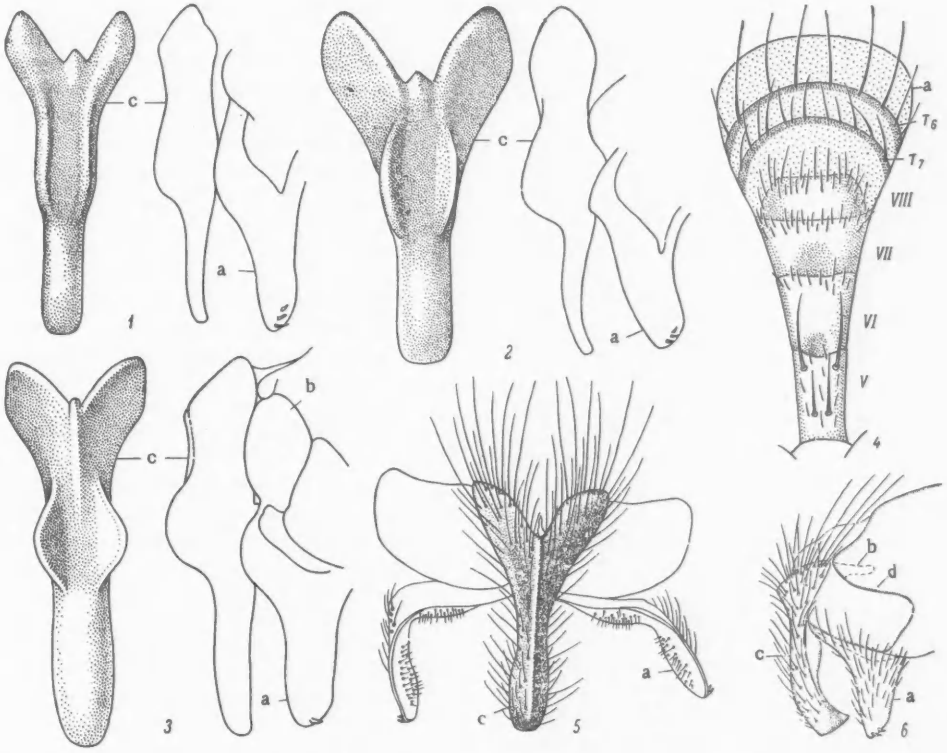


Fig. 4. Morphological details of abdomen among the Ernestine (Originals) 1) cerci and coxites of Fausta inusta Mesn. (posterior and lateral views); 2) ditto for Fausta nemorum Meig.; 3) ditto for Fausta mimetes sp. nov.; 4) terminal abdominal segments in female Lypha dubia Fall.; 5) cerci and coxites of male Micronychia ruficauda Zett. (in posterior view); 6) ditto in lateral view. Letters a,b,c, as in Fig. 1 and 3; d) lateral process of tergite 9.

reddish; there are longitudinal stripes of light colored bloom on the notum, separated from each other by three broad bands of the basic color of the notum; the median band is often divided in the middle of the prescutum into two narrow stripes which fuse together at the beginning of the scutum immediately behind the transverse suture. Acrostical setae 0(1, 2) + 3(2), dorsocentral setae 3+3, intra-alary 0+3, humeral 4-5, post-humeral 1, pre-alary 1, supra-alary 2, sometimes with one to two slender setules in front of each of these; post-alary 2, sternopleural 2 + 1; prothorax expanded considerably at the front. Apical setae of scutellum absent (as a rare exception they may be present but very small), pre-apical (1), lateral (1), sub-basal (1) and basal (1), all very long and slender; discal 2 rarely 4. Scutellum with very long erect, setiform hairs. Squammae white, halteres yellow. Wings sometimes with a dark rust-colored tint in the region of cell A and Bas_2. Bend of vein m is a right-angle; the length of its sector varies from between 1/5 to 1/2 the length of the preceding sector of the medial vein; r_{4+5} with one to seven slender setiform hairs on thickened part of vein at its base; R_5 open. Posterior transverse vein somewhat curved; costal spine not developed. Limbs brown, tibia often reddish-yellow or brownish; claws of anterior tarsi in males longer than, and in females equal to, or shorter than fifth tarsal joint; tarsal joints of anterior limbs shortened except for fifth, not expanded. Abdomen glossy, brown, with greyish-white bloom which only covers the front half of the tergites; sides of tergites 3 and 4 with small reddish-brown or rust-colored spots, or these may be absent. In males tergite 6 is separated from the subsequent segment of the hypopygium by a narrow membrane (Part 1, Fig. 4, 1), which is usually covered with grey bloom; it is also separated by a membrane from the fifth tergite, on the posterior edge of which occur long, slender hairs. Lateral processes of tergite 9 oval, small (Part 1, Fig. 4, 1) glossy, covering anterior edge of coxite bases; cerci small (Fig. 4, 2) narrowly triangular at the base, the apical half is in the form of a narrow, blunt or rounded piece; triangular or rectangular ribbing grows up from the base at each side. Coxites elongate, rounded at the end with two to five small toothlets on the side; sternite 5 cleft over slightly less than half its length by a narrow notch; posterior margin of sternite with two tongue-like or triangular outgrowths, rounded at their apices; lateral posterior angles of sternite extend further back than the median processes. Tergites 6-7 in female incompletely fused, forming narrow strips which are sharply constricted or interrupted completely on the dorsal side; sternites 6 and 7 have a total length less than that of sternite 5 or equal to it; sternite 7 with a tuberculate outgrowth in the middle of its posterior margin (Fig. 5, 4, 5).

In both sexes the abdomen has discal median setae on tergites 3 and 4, numering to to five pairs on each. Body length 7 to 13 mm.

IDENTIFICATION KEY FOR SPECIES OF GENUS FAUSTA R.-D.

1 (4) Proboscis slender, length of mentum 7-8 times its diameter (Fig. 2, 5).
2 (3) Tergites 3 and 4 bear two thick discal setae; posterior margin of scutellum dark reddish--yellow; tibiae rusty-yellow; breadth of frons in male slightly more than half the diameter of the eyes. Body length 9.8-10.2 mm. . . . . 5. F. bey-bienkoi, sp. n.
3 (2) Tergites 3 and 4 each with six to eight slender, asymmetrically arranged discal setae; scutellum blackish-brown; frons of male one third breadth of eyes. Body length 9-10 mm. . . . . 4. F. mimetes, sp. n.
4 (1) Proboscis of normal proportions, length of mentum 3.5-4 times its diameter (Fig. 2, 3).
5 (8) Orbital setae absent (in male).
6 (7) Tergites 3 and 4 each with two stout discal setae and small brownish red patches at the side; these latter may be absent; tibiae deep brown; breadth of frons 0.4-0.7 breadth of eyes. Sides of cerci raised up in the form of auricles (Fig. 4, 2). Body length 9-11 mm. . 1. F. nemorum Meig.
7 (6) Tergites 3 and 4 each with four or more discal setae and large rusty-yellow hairs at the sides; frons one third the width of the eyes; lateral parts of cerci are raised in the form of shallow keels which are of almost the same length as the distal parts (Fig. 4, 1) . . . . . 3. F. inusta Mesn.
8 (5) Frons with large orbital setae (Females)
9 (10) Tergites 3 and 4 bear two stout discal setae; tibiae dark brown or chestnut; scutellum usually all black. . . . . 1. F. nemorum Meig.
10 (9) Tergites 3 and 4 each with more than two discal setae, which are slender and asymmetrically arranged; tibiae rusty-red; scutellum at its apex and along the whole of its posterior edge reddish yellow.
11(12) Fused tergites 6 and 7 with long setae (Fig. 5, 5), arranged in two irregular rows; frons almost as wide as the diameter of the eyes; scutellum with a reddish-brown patch at the tip. . . . . 3. F. inusta Mesn.
12(11) Fused tergites 6 and 7 with short setae, arranged in a single row; breadth of frons 0.7 times the diameter of the eyes; scutellum with its free edge reddish-yellow. Body length 7-9.2 mm. . . . . 2. F. separata, sp.n.

1. Fausta nemorum Meigen

Male. Breadth of frons at narrowest point 0.4-0.7 times width of eyes. Genae almost 1.5 times as wide as third antennal segment; antenna blackish brown; base of third antennal segment on the inside and tip of second segment

reddish; length/breadth ratio of third segment 1:1.3-1.5; this segment is slightly expanded at its apex. Proboscis short, mentum 3.5 times as long as broad; palps yellow; face genae and orbits with white bloom, occiput and subgenae with greyish bloom. Frontal setae on genae set close together, five in number, usually in two rows (Fig. 2, 3). In front and behind the rows of frontal setae on the gena are a few additional setae or stout setiform hairs. Thorax brownish black; scutellum not infrequently brownish at the tip. Pale grey or bluish grey bloom covers the notum, on which there are three broad brown stripes (these fuse in the middle to form a single tapering band anteriorly). Acrostical setae 2+2, anterior pair in front of suture slenderer than posterior, often hair-like. Wings unevenly smoky at the base; base of r_{4+5} with four to five hairs; angle of median vein with branch, the length of which is only only one third that of preceding branch of the same vein. Limbs blackish brown; length of claw and pulvillus equal to length of the two distal joints. Lateral portions of tergites 3, 4 and 5 usually with indistinct brownish patches. Pale grey bloom covers both top and bottom of abdomen, leaving on tergites 3 and 4 a strip of brown behind the marginal setae. Tergites 3 and 4 with two setae each. Tergite 6 forms a narrow band covered with grey bloom and separated by a furrow from the next glossy black segments of the hypopygium, which may have a reddish posterior margin; tergite 9 glossy black with long slender setae and setiform hairs. Cerci as shown in Fig. 4, 2.

Female. Frons just slightly narrower than eyes; its posterior part together with upper surface of occiput devoid of bloom. Median stripes of notum fused into one. Segments of anterior tarsi not expanded. Coloration of abdomen as in male. Terminal abdominal segment as in Fig. 2, 5. Body length 9-11 mm.

This is a species which is met with infrequently; it is known from Europe, where it is represented by material from the Leningrad and Moscow Regions and from Caucasia (Tebedra).

2. Fausta separata, sp. nov.

Female. Width of frons 0.7 times that of eyes. The frontal strip is light yellowish red and tapers slightly in front of the eyes, at which level it is barely as wide as the orbit; breadth of genae half that of diameter of eyes and slightly more (10:9) than the breadth of the third antennal segment; antennae chestnut brown, with two narrow stripes at the base of third segment; these stripes are reddish-yellow; ratio of lengths of second and third antennal segments is 7:6, third segment slightly expanded distally; its length is 1.5 times its breadth at the apex. Length of mentum is four times its diameter. Orbits and genae with dense greyish white bloom; face with scanty bloom of same color; occiput and subgenae with darker, dull bloom. Frontal setae two to three, with two more short setae in front of them. Thorax brownish-black; tip of scutellum, post-alary tubercles and mesophragma a reddish brown, scutum glossy, with three black stripes of which the middle one has a distinct patch of grey bloom in front of the suture; the light colored stripes of bloom, which are separated from each other by darker bands, are expanded anteriorly; they are one third the width of the black stripes. Acrostical setae 0+2(1); apical setae absent from scutellum. Bend in vein m right-angled; its branch is a fifth to an eighth the length of the preceding branch of the medial vein. The base of r_{4+5} has two to three small hairs. Limbs dark brown, tibiae rusty-yellow; terminal joints of anterior tarsi slightly shortened but not expanded. Abdomen dark brown above, chestnut brown beneath, glossy; its light colored bloom is sparse and extends over two thirds of tergite 3 and the whole of tergites 4 and 5; it is iridescent, greyish white and readily visible with lateral illumination. Discal setae on tergites 3 and 4 number two pairs. Fused tergites 6 and 7 form narrow transverse strips along the posterior margin of which is a single row of erect, setiform hairs. Sternite 6 concave posteriorly and hence the lateral parts of sternite 7 project from under it; sternite 6 with a short triangular (membranous ?) depression at the base. Sternite 7 with a tuberculate, sloping prominence in the middle of its posterior margin. Body length 7-9.2 mm.

Description based on two females: 1 f. (holotype)--Altai Mts., from R. Ady to R. Matur, July 11th 1897 (Wagner); 1 f.--Dzezin, near Abakana, Khakasskoi region, July 9th 1897 (Wagner).

3. Fausta inusta Mesnil

Male. Frons one third as wide as eyes; width of genae half that of eyes. Antenna brown; apical half of second antennal segment rusty red; the narrow proximal border of the third segment may be the same color; third antennal segment slightly expanded at apex, ratio of lengths of segments 2 and 3 is 1:1-1.2; diameter of third segment is 0.75 times its length; length of mentum is 3.5--4.5 times its diameter; orbits, genae, median field and face are all covered with a silky, greyish white bloom, while the subgenae and occiput are covered with a dull, pale grey bloom; occiput with dense yellowish grey hairs; genae with long, brown hairs. Above the angular vibrissae are one to three short setae and a few hairs, behind which are one to two rows of setiform hairs. Internal setae of vertex are short but rather stout. Thorax brownish black, glossy; scutellum dark reddish brown at the apex or along its posterior edge; in the latter case the base and middle of the scutellum is covered by a large, triangular black patch. The longitudinal stripes of pale colored bloom on the prescutum are clear and distinct; their width is a quarter to a third that of the three dark colored stripes. Pleural and humeral prominences with sparse, light grey bloom. Acrostical setae 1+2; apical setae absent from scutellum, lateral setae number two pairs, discal setae one pair, rarely two pairs, in which case the internal pair is poorly developed. Bend on vein m is right-angled,

length of sector 1/8-1/2 that of the preceding sector of the median vein; R_5 open; r_{4+5} with two to three small hairs; abdomen brownish black; at the side of tergites 3 and 4 are small dark brown or large rust-red patches; light grey bloom on tergites 3, 4 and 5 covers the whole of the surface of these segments. Discal setae on tergites 3 and 4 number three pairs or more and are not always symmetrically arranged; tergites 1 and 2 usually with a pair of feebly developed, median marginal setae. Limbs brown, tibiae rust-red or chestnut. Cerci as shown in Fig. 4, 1.

Female. Breadth of frons only slightly greater than that of eyes. Scutum with three very broad, longitudinal, black stripes, separated from each other by two narrower bands of light grey bloom. Abdomen without lateral red patches; discal setae on tergites 3 and 4 number two and three respectively; terminal abdominal segments as shown in Fig. 5, 5. Body length 9.5-10.7 mm.

The description of this species is based on material from the following places: 1m. and 1f. – Khuzino, Irkutsk Region, July 23rd, 29th 1949 (Kolomnets); 1m. – Krasnoyarsk, July 27th 1953 (Kolomnets); 1m. – R. Aldan near mouth of R. Tympton, Yakutsk ASSR, June 29th 1926 (Zaikov); 1 m. – "Siberia"; 1 m. – near town of Yujno-Sakhalinsk, Sakhalin Isles, June 23rd 1952 (Violovich).

This species was first described by Mesnil in 1957. His description is very short and given in a comparative manner. Comparing this species with F. nemorum Meig. and P. nielseni Villen, Mesnil suggested that it had affinities with these two representatives of different genera but that Fausta inusta could be readily distinguished by the structure of its terminal abdominal segments in both sexes and by the arrangement of its setae. As far as can be ascertained from his short diagnosis of the species, Mesnil assigned F. inusta to the genus Fausta R.-D. basis of the presence of a branch to the medial vein.

Our examples from Siberia and the Sakhalin Isles diffe slightly from Mesnil's specimens of F. inusta: in their larger internal setae on the vertex; in the somewhat wider frons of the male and also in the distinct yellowing of the wing membrane along the veins.

4. Fausta mimetes sp. nov.

Male. Frons 1/4 the width of the eyes. The greatest width of the genae is 0.6 that of the eyes and 1.5 times the width of the third antennal segment. Ratio of lengths of second and third antennal segments is 6:7; third segment expanded at its distal end and here its breadth is only slightly less than its length (5:6). Antennae brown, second antennal segment pale rust color at its distal end and along its inner side. Proboscis elongate, mentum seven times as long as broad; palps light yellow. Head brownish-black, face greyish-yellow; orbits, genae, median area and face covered with glossy, greyish-white bloom; occiput and subgenae with duller, greyish bloom. Frontal setae three in number. Above the angular setae are found three short setae and some rather short hairs. Occiput with dense, yellowish grey hairs. Thorax blackish-brown, glossy; there are three, broad, longitudinal, dark colored stripes on the scutum separated from each other by two stripes of greyish white bloom; the later are only half as wide as the broad stripes. Acrostical setae 1+3; apical setae of scutellum absent; there are two discal setae on this sclerite. Wings greyish, with rust-colored bases and a brownish tinge around r-m. Cell R_5 wide open; bend in vein m right-angled, its branch is only a fifth the length of the preceding sector of the median vein; base of r_{4+5} with two hairs; external costal spine very small. Squammae white; halteres light yellow. Claws rather longer than fifth tarsal joint. Abdomen brownish-black; sides of tergites 3 and 4 dark brown; tergites 3, 4 and 5 with rather scanty, pale grey bloom over their basal two thirds, in the posterior third the bloom disappears altogether. Tergite 3 with two pairs of erect discal setae, one pair behind the other; on tergite 4 there are five single setae, of which one is in front and the other four form a short row. Sternite 5, cerci and coxites as shown in Fig. 4, 3.

Female. Breadth of frons slightly greater than that of eyes (11:10); second antennal segment light brown, rust-colored at the tip; second and third segments of equal length. Thorax brownish black; the middle dark stripe on the prescutum is divided by a strip of bloom into two stripes, each of which is slightly narrower than the dividing strip of bloom; behind the suture the middle dark-colored stripe is broad. Abdomen wider than in male, brownish-black; the light-colored bloom at the base of tergites 3, 4 and 5 is quite distinct and forms a narrow stripe on each segment; farther back the bloom is only visible when the tergites are viewed with lateral illumination. There are two pairs of discal setae on tergites 3 and 4. The fused tergites 6 and 7 have a single row of semierect, setiform hairs with a few (2-4) normal hairs behind them. Length of sternites 6 and 7 together is a little less than that of sternite 5 (Fig. 5, 4), in all cases their breadth exceeds their length; the afore-mentioned sternites are slightly concave posteriorly; there is a tuberculate prominence in the middle of the posterior edge of sternite 7. Body length 9-10 mm.

The description of this species is based on two examples: 1m. (holotype) – R. Kyzas, a tributary of R. Abakana, Khakasskoi Region, July 10th 1897 (Wagner); 1f. (allotype) – R. Kunsuk, Kemerovskoi Region, July 10th 1897 (Wagner).

5. Fausta bey-bienkoi, sp. nov.

Male. Greatest width of frons is just slightly more than half the diameter of the eyes (5:9); genae naked, half as wide as eyes and 1.5 times as wide as third antennal segment. Antennae rusty brown, basal part of second segment and all third segment dark brown; third segment slightly expanded at distal end, its maximum width is half its length. Proboscis long and narrow; submentum

slightiy longer than antenna, 7-8 times as long as it is broad (Fig. 2, 5); palps rust yellow. Head brownish--black; face greyish-yellow, median area rusty red. Orbits, genae and median area with dense greyish-white bloom; subgenae and occiput with duller, light grey bloom. Internal setae of vertex long and slender, outer vertical setae shorter and just slightly thicker than the inner ones, clearly distinguishable from ocular cilia; frontal setae three in number; vibrissae long; there are three short setae and a few hairs above angular setae; occiput densely covered with yellowish-grey hairs. Thorax brownish-black, glossy; scutum with three broad stripes of the same color, separated from each other by strips of pale grey bloom; the middle dark stripe on the prescutum is twice as broad as the strips of bloom; scutellum with a reddish-brown stripe along its edge; base of scutellum with a triangular brown patch; there are two pairs of acrostical setae, one in front and one behind the suture; the two posterior setae are the same length and thickness as the neighboring dorso-centrals. Wings greyish with a light shading of deep yellow at the base. R_5 wide open, branch at bend of vein m only one third the length of the preceding sector of the medial vein. Vein r_{4+5} with two short, stiff hairs at the point where it thickens. Limbs brown, tibiae rusty-brown. Abdomen glossy, brownish-black; at the sides of tergites 3 and 4 and in the anterior half of the same structure there are small clay-yellow patches, hardly distinguishable from the rest of the dorsal surface of the abdomen. Tergites 3, 4 and 5 with pale grey bloom anteriorly; there are two stout discal setae on tergites 3 and 4; cerci with short triangular processes (one in the middle of each side) as in F. mimetes, sp. nov.; the distal half of each cercus tapers toward the tip, as in the other species of the genus. Coxites with four very small toothlets at the apex. Female. Breadth of frons equals breadth of eyes; orbits 1.5 times as wide as frontal strip. Median dark stripe on scutum is divided by a broad strip of greyish bloom into two narrow stripes in the prescutal region; these fuse again at the suture. Apical scutellar setae small, intersecting. Fused tergites 6 and 7 with a single row of long, setiform hairs along their posterior edge; sternites 6 and 7 glossy brown; their joint length is less than the length of sternite 5, which is covered with slender, setiform hairs; sternite 6 very slightly concave posteriorly; sternite 7 with an almost straight posterior edge and a tuberculate prominence, densely covered with extremely small hairs. Abdomen devoid of any yellow tinge at the side. Claws of anterior limbs slightly shorter than fifth tarsal joints. Body length 9.8-10.2 mm.

This description is based on two examples: 1 m. (holotype)—Alma-Ata, June 15th 1936 (Birulya); 1 f. (allotype)—Ketmen, N.E. Tyan'-Shan, Chormak survey point, July 28th 1948 (Bei-Bienko).

This species is named in honor of Grigoriya Yakovlevicha Bei-Bienko.

8. MICROERIGONE GEN. NOV.

Frons juts out anteriorly; in male it is half width of the eyes, in the female it equals the latter; face tapered posteriorly; the ventral edge of the face hardly projects forwards at all (Fig. 2, 1); frontal strip 2-2.5 times as wide as orbits; genae below frontal setae with three to five short, stiff hairs, half the width of the eyes and 1.4 times as broad as the third antennal segment; occiput rather convex; height of subgenae half the vertical diameter of eyes. Eyes with dense, light-colored hairs. Third antennal segment somewhat expanded at the tip or parallel-sided, 1.5-2 times longer than second segment; arista long, thickened basally. Proboscis short, with large sucking lobes (labellum); mentum just slightly longer than third antennal segment; palps slightly thickened at the apex. Frontal setae two to three. External setae of vertex, orbital (2) and prevertical (1) only developed in female. Above the angular vibrissae are three to five small setae; occiput with light-colored hairs, behind the poste-ocular cilia are numerous, irregularly arranged, small setae and black hairs. Subgenae with yellow-brown hairs and with setae along their posterior margin. Scutum with four longitudinal, dark-colored stripes; prothorax and anterior pleura without hairs. Acrostical setae 2+ 3, dorso-central 3+ 3, intra-alary 0+ 3, humeral 5 post-humeral 1, rarely 2 (in which case the posterior is very small), presutural 1, pre-alary 1, the feeble supra-alary 2 or 3 (in the latter case the anteriormost is short), post-alary 2, sternopleural 2+ 1, apical setae of scutellum intersecting, somewhat shorter and slenderer than pre-apical, lateral 1, basal 1, pre-basal 1, the two discal are very slender. Cell R_5 narrowly open or closed by edge of wing; bend in medial vein right or obtuse angled; branch of median vein a fifth to a seventh length of previous sector (shorter in female than in male); vein r_{4+5} with two to four short hairs at its base; posterior transverse vein bent into a slight S-shaped curve; external costal spine half as long as median transverse vein. Limbs always, to a greater or lesser degree, yellow. Claws and pulvilli on anterior limbs longer than fifth tarsal joint in male; in the female they are somewhat shorter than the latter; the length of the distal three tarsal joints exceeds their breadth in the female. Abdomen glossy, brownish-black in both sexes, with large reddish-yellow patches laterally. Tergites 6 and 7 united in male; the boundary between them marked by a faint furrow. Tergite 6 in the form of a narrow strip, without any setae and usually without hairs. Lateral processes of ninth tergite very small, convex, oval (Fig. 1, 6). Proximal part of cerci triangular, narrow; distal part in the form of narrow, blunt-ended structure slightly bent in the middle; coxites short, triangular, narrow, rounded at the distal end, without spinules. Sternite 5 with a narrow, longitudinal groove in its posterior half and a short, rounded, median outgrowth.

In the female, tergites 6 and 7 are not fused together (Fig. 3, 7); the sixth tergite is represented by two narrow sclerites, which are in contact along the mid dorsal line of the body; sternite 5 is 2.5 times as long as sternite 6, the former has a narrow, light-colored, longitudinal depression and its posterior edge is concave. Sternite 7 with convex posterior edge. In both sexes tergites 3 and 4 bear two discal setae. Body length 7--9 mm.

1. Microerigone sima, sp. nov.

Male. Head (Fig. 2, 1) brown, median area and frontal strip rust-red, lower part of face greyish-yellow; orbits, face, genae, median area and subgenae with greyish white bloom. Antennae brown, sometimes the apex of the second antennal segment and the base of the third reddish; third segment rounded at the tip; arista rust-colored, its first segment is only half as long as the second; palps yellow-rust colored. Thorax brownish black, post-alary prominences and scutellum, except for its base, dark clay-yellow; scutum with longitudinal strips of light grey bloom, which are well represented on the prescutum and delimited by four dark stripes of which the middle ones are only a third to half as wide as the strips of bloom. Pleura uniformly colored with grey bloom. Squammae yellow with white bloom. Halteres pale -yellow; wings greyish with a light yellowish cast and a distinct yellow color at the base; veins greyish-yellow, pale. Anterior thoracic spiracles with golden -yellow hairs on their peritremes. Limbs brown, tibiae of middle limbs rusty brown over their distal two thirds. Abdomen glossy brown or black; tergites 1, 2, 3, 4 and sometimes 5 reddish-yellow at the base; there are large light-colored patches on tergites 3, 4 and 5 with very narrow stripes of white bloom which only extend over a fifth to a sixth of the length of these tergites. In the female the abdomen is wider than the thorax; the reddish-yellow coloration at the side extends over rather more than a third the breadth of tergites 1, 2, 3 and 4; femora and tibiae apart from their apices, light reddish--yellow, tarsi and apices of femora brown. Anterior tarsi with shortened but not expanded joints. Sternite 6 with a narrow, pale-colored,longitudinal depression in the middle (Fig. 3, 7) and glossy brown at the sides; sternite 7 dull, with small hairs. Body length 7-9.5 mm.

This description is based on six examples: 1 m. --Borovoe, Akmolinskoi Region, July 21st 1937 (Zimin); 1 m., 2 f. (among which are the holotype male and the allotype female)--R. Kamzas, a tributary of R. Magazy, above the Tomi River, June 22nd-25th 1908 (Khvorov); 1 m.--Artybash, northern shore of Lake Teletsko, Altai, June 17th 1909 (Emel'yanov); 1 f.--Khuzino, Irkutsk Region, June 29th 1949 (Kolomnets).

9. ANAMERIANA GEN. NOV.

Frons of male a third as wide as eyes, without orbital setae, projecting well forwards; face slopes backwards, antero-central margin of face does not project forwards (Fig. 2, 2). Width of genae at the level of the antennal bases is 0.6 times width of eyes; below the frontal setae the width of genae is a little greater than that of the third antennal segments; height of subgenae a little less than half the vertical diameter of the eyes (2:4.5). Antennae elongate, second segment is a third length of third segment, last segment slightly expanded at the base, over the rest of its length it is almost parallel sided; arista thickened over its proximal two thirds. Proboscis short, with very large sucking lobes; mentum just a little shorter than third antennal segment; palps somewhat expanded over the whole of their length. Genae above frontal setae with several long, setiform hairs; subgenae and occiput with slender hairs and no setae. Eyes with dense, light-colored hairs. Scutum with three, broad, dark-colored, longitudinal stripes; central portion of the middle stripe has a scanty covering of grey bloom; the light-colored strips which separate the broad stripes are narrower than the latter. Acrostical setae 3+3, dorsocentral 3+4, intra-alary 1+3, presutural 1, humeral 3-4, pre-alary, long and slender 1, supra-alary, stout 2, post-alary 2, sternopleural 2+1; the apical setae on the scutellum are capillariform, pre-apical (1), lateral (1) and basal (1), all long and relatively large. Thorax setae long and slender. Prothorax narrow, without hairs; squammae white; internal margins of thoracic squammae yellowish brown. Wings greyish; bend of vein m right--angled, without branch or fold; r-m, the tip of m and the posterior transverse vein somewhat darkened in color. Costal spine absent; R_5 open; median and posterior tibiae with one ventral seta, the latter with a comb of slender, almost equal setae along the antero-dorsal surface. Claws and pulvilli longer than fifth tarsal joint. Abdomen covered all over with dense greyish-white bloom; tergites 3 and 4 with numerous discal setae. Sternite 5 cleft longitudinally almost to its hinder end; sternites 2, 3 and 4 narrow, the first two not completely visible; tergite 6 completely fused with tergites 7 and 8; hypopygium small, shorter than tergite 5, covered with grey bloom and a few short hairs. Tergite 9 convex with long setae and hairs, lateral processes narrow, cerci cylindrical, elongate, gradually tapering towards the apex, flattened laterally over the distal third of their length, almost straight over the rest and with a shallow longitudinal keel in the middle. Coxites broad, slightly chamfered at the apex and pointed, with shortish hairs in patches along their ventral edges (Fig. 5, 1).

In the nature of its habitat and several morphological respects (arrangement and number of setae, structure of terminal abdominal segments) this species appears close to Panzeria R-D, although at the same time differing from the latter as follows: In the structure of its cerci and coxites in the male; in the fact that the ventral margin of the face does not project forwards etc.

1. Anameriania albomicans, sp. nov.

Male. Head (Fig. 2, 2) blackish-brown, face yellow-rust

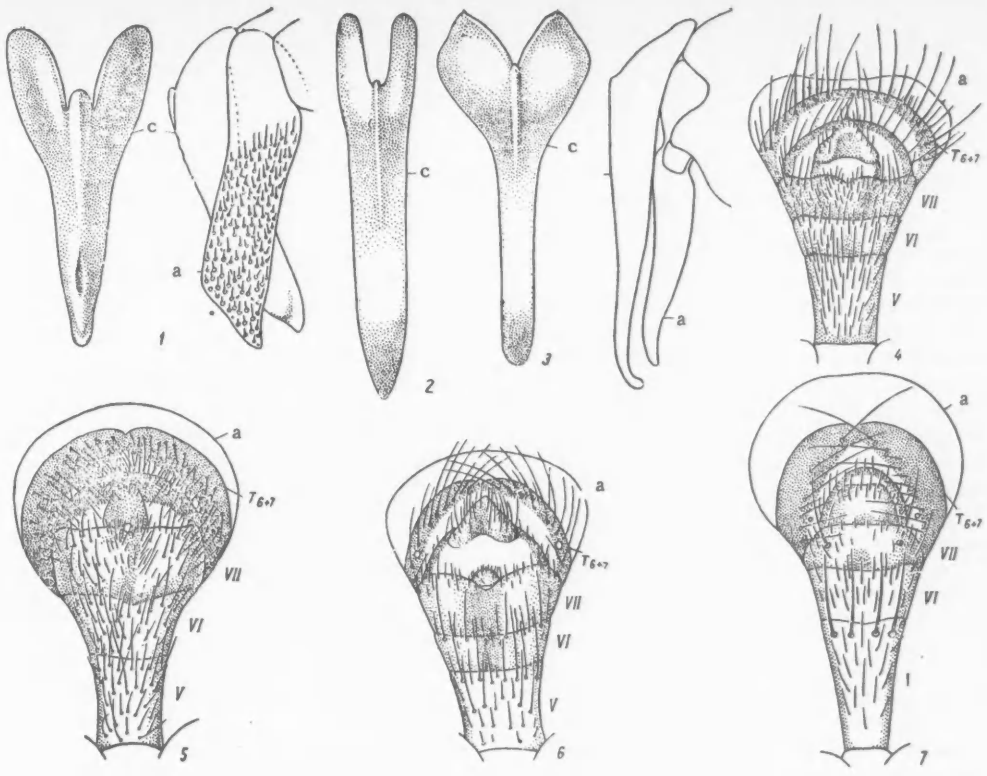


Fig. 5. Details of abdominal morphology among the Ernestiina (originals). 1) cerci and coxites of male Anameriania albomicans sp. nov., posterior and lateral views; 2) ditto for Mimomeriania elongatula sp. nov.; 3) cerci of male Meriania puparum puparum F., posterior view; 4) terminal abdominal segments of female Fausta mimetes sp. nov., ventral view; 5) ditto for Fausta inusta Mesn.; 6) ditto for Meriania puparum puparum F.; 7) ditto for Micronychia ruficauda Zett. Letterings as in Figs. 1 and 3.

colored; median area and anterior edge of genae red; frontal strip reddish-brown, gradually becoming broader anteriorly, at its narrowest part it is only slightly narrower than the orbits; frons one third the width of the eyes. Bloom on orbits and on genae white with a greyish tinge; occiput and subgenae with a scanty, dull grey bloom. Frontal setae extends as far as the tip of the second antennal segment; they are irregularly arranged; below these setae are a few long, stout hairs. Subgenae with black hairs mixed with yellow hairs ventrally. Vibrissal keel above the angular setae with two rows of closely set, slender, filiform setae, which occupy up to half the height of the keel. Occiput with dense yellowish-grey hairs. The first two antennal segments are reddish--yellow, the third is brown with a chestnut brown arista; the second segment bears many setae along the whole of its inner dorsal edge, as well as the usual terminal setae. Palps yellow, with numerous short, setiform hairs. Thorax blackish-brown with scanty grey bloom, divided along the notum by three dark-colored stripes; bloom on pleura very scanty. Central portion of the middle stripe with scanty bloom. Scutellum reddish-brown, at the base dark brown. Halteres yellow. Wings greyish, with a slight brown shading near r-m, along the apical and posterior transverse veins and cells A and B_2. Base of r_{4+5} with two setules. Limbs with relatively slender tibiae and tarsi; femora brown, internal surface of anterior coxae, the whole of the middle coxae, trochanters and tibiae reddish-yellow; tarsi yellowish-brown. Claws and pulvilli longer than fifth tarsal joint. Abdomen blackish-brown, covered all over with greyish-white bloom, forming light and dark-colored patches. Red patches at the sides of tergites 3 and 4, one quarter of the way along the tergites. Tergite 1+2 with two marginal setae, tergite 3 with a few irregularly arranged discal and six marginal setae along the whole of the posterior edge; tergite 5 with four transverse rows of setae, reaching almost to the front edge of the segment.

Features of the other segments were given in the generic diagnosis. Body length 13 mm.

This description is based on a single male hollotype from the Far East: Yakovlevka, Ussuri Land, May 16th 1926 (D'yakonov, Filip'ev).

10. MICRONYCHIA BRAUER (= Eversmannia R.-D.)

Frons in male half as wide as eyes, in female width of frons equals that of eyes; ventral margin of face does not project forwards; height of subgenae is two fifths the vertical diameter of eyes. Shortest width of genae is a little less than diameter of third antennal segment and only one third width of eyes. Occiput slightly convex, median area very narrow (Fig. 3, 2). Antennae long, their tips projecting beyond the lower edge of eyes; third antennal segment three times as long as second, slightly concave along its upper margin; arista long with basal half thickened. Proboscis short; length of mentum 2--2.5 times its breadth; palps cylindrical, slightly thickened at distal end. Frontal setae number five to six; prevertical setae project forwards and the two orbital setae only occur in females. Subgenae with a few, stout, setiform hairs and with setae along their ventral margin; occiput with two rows of rather large setae behind the post-ocular cilia and light-colored hairs elsewhere. Ocular setae relatively shorter and stouter than the frontal. Above the angular vibrissae are five to seven setae. Thorax blackish-brown, scutellum rusty-yellow; scutum with four dark-colored, longitudinal stripes. Peritremal hairs of metathoracic spiracles do not form leaf-like lobes (Part 1, Fig. 4, 7). Acrostical and dorso--central setae 3+3, intra-alary setae behind suture 3, presutural 1, humeral 4, post-humeral 1, large, in addition there may be a second small post-humeral seta; pre-alary slender, short, 1; supra-alary, 2 large setae and 1-2 very small ones. The scutellar setae are as follows: Apical (1), half as long as pre-apical, basal (1), lateral (1), and a very long pre-apical (1), and 4-8 discal setae which are short and slender. Prothorax and anterior pleura without hairs; claws of anterior tarsi in male are as long as the fifth tarsal joints, in the females they are shorter than the latter; tarsal joints 4 and 5 transversely flattened in female. Cell R_5 open; bend in median vein is right-angled, occasionally it is furnished with a small process or just thickened; basal part of r_{4+5} with four to seven setae; posterior transverse vein straight; costal spine one third the length of the median transverse vein. Abdomen convex, dorsally sixth tergite is almost linear in male, its lateral portions are slightly expanded and here its surface is almost perpendicular to the longitudinal axis of the body; lateral process of tergite 9, large, convex and covering bases of coxites (Fig. 4, 6). Cerci convex, expanded at the base and curved like a bow, their distal ends are blunt and there is a triangular outgrowth on the ventral surface; coxites linguiform, narrow, with two to four fine teeth at the apex. Sternite 5 deeply cleft in two; median outgrowth of posterior margin broadly rounded and projecting backwards to a less degree than the lateral portion of the sternite.

In the female tergites 6 and 7 are represented by a single, narrow, semicircular sclerite, constricted or divided along its dorsal line and with a single row of long setae along its posterior margin; these setae have slender hairs between them. Sternite 6 is 1.2-1.5 times as long as sternite 7 while sternite 5 is 2.5 times as long as sternite 6; sternites 6 and 7 are twice as broad as long. Body length 7-7.5 mm.

1. Micronychia ruficauda Zetterstedt

Head blackish-brown; median area reddish-yellow, frontal strip dark brown, antennae brown with a reddish tinge at the base of segment 3 and the tip of segment 2; palps yellow; orbits and genae with greyish-white bloom, face with lighter bloom of the same color, occiput and subgenae with scanty, dark-grey bloom. Thorax blackish-brown; scutellum and usually the post--alary prominences rusty-yellow; scutum with four narrow, longitudinal, dark stripes, separated by pale grey intervals; pleura with grey bloom. Limbs blackish--brown. Wings (Fig. 3, 4) greyish with broad shading along the median transverse vein and narrow shading at the end of the posterior transverse vein. Squammae grey with white bloom, the outer margin is pale brown and the inner margin a brighter colored brown. Abdomen blackish brown; posterior third of tergite 5 orange-yellow in female, in the male the posterior quarter of the same tergite is rust-yellow, as in the hypopygium. Cerci dark brown in male. Sternite 4 with a dense tuft of setae on its posterior margin in the male. Abdomen with light grey bloom in place of the white bloom. The ninth tergite of the male has scanty white bloom. Body length 7-7.5 mm.

This is a rare species found in Northern and Central Europe, including European USSR.

11. LYPHA ROBINEAU-DESVOIDY

Frons in male one third as wide as eyes; in the female the width of the two is equal. Median area and genae narrow (Part 1, Fig. 4, 9); breadth of latter is one third that of eyes; height of subgenae less than half diameter of eyes. Occiput slightly convex. Third antennal segment 2-2.3 times as long as second, somewhat wider than genae, parallel-sided, its upper surface not infrequently concave. Arista thickened over its basal half, slender at the apex. Eyes with long, light colored hairs. Proboscis very short; mentum twice as long as broad. Palps expanded and flattened distally. Orbital (2), prevertical and external vertical setae only present in female; frontal setae four to five in number, situated below middle of eyes; angular vibrissae long and stout; above them on the same plane as the lower frontal setae are

six to seven short, equal-sized setae; subgenae with a few brown hairs and setae. Occiput with light-colored hairs and with two rows of small setae behind post-ocular cilia. Acrostical setae 2(3)+3, dorso-central 3+3, intra-alary 0+3, humeral 4, post-humeral 1; apical setae on scutellum only a third as long and considerably more slender than pre-apical, intersecting; in addition the scutellum has 2 basal, 1 lateral, and 8-10 discal setae. Prothorax and anterior pleura without hairs; anterior ventral sternopleural setae set at almost equal distances from the two apices. Limbs blackish-brown; pulvilli and claws of anterior tarsi almost equal to fifth tarsal joint in male and shorter than the latter in female. The three distal tarsal joints are slightly inflated in the female. Cell R_5 slightly open or bounded by the wing margin; bend in median vein right- or obtuse-angled, its process is very short or absent altogether; r_{4+5} with three to five relatively large setae basally; costal spine either half as long as median transverse vein or almost the same length. There are four to six discal setae on abdominal tergites 3 and 4. Hypopygium (tergites 7+8) in male is seven to eight times as long as the previous segment from which it is separated by a deep furrow; tergite 6 barely protrudes from under the posterior margin of tergite 5 and lacks setae and hairs; tergites 7 and 8 are fused into a single sclerite with two rows of long setae; tergite 9 with an anterior row of very long setae and one to two posterior rows of shorter setae; its lateral processes are small, convex and linguiform; they overlap the coxite bases; cerci are slightly expanded over their distal halves and possess dull, convex basal portions; their apical portions are glossy and sharply rounded at the tip. Ventral surface of cerci immediately behind the apices with two small, forwardly directed, triangular processes. Sternite 5 half as wide as previous sternite, from the posterior margin of which it is cleft by a longitudinal notch which reaches the middle of the fifth sternite; the triangular outgrowths from the posterior margin extend backwards to a less extent than do the lateral portions of the sternite. In the female, tergites 6 and 7 are represented by narrow semi-circular sclerites, bearing a row of setae; tergite 8 is at a considerable distance from the subgenital plate, which has the form of a very narrow, semicircular ring, bearing a few short, setiform hairs. Sternites 6 and 7 flat, almost equal in length, each slightly shorter than sternite 5; width of sternite 7 slightly greater than that of 6; sternite 8 forms a transverse plate (Fig. 4, 4). Body length 5.5-6.8 mm.

1. Lypha dubia Robineau-Desvoidy.

Head blackish-brown, frontal strip and median area reddish-brown; genae, anterior part of orbit and face with light grey bloom. Palps brown or rust color distally. Occiput with yellowish-grey, slender hairs and fine setae behind the post-ocular cilia. Thorax blackish-brown; scutum of male with three, broad, longitudinal, dark stripes, that of female with four; the middle stripe in the male is half as wide as the two laterals from which it is separated by a light grey area. Pleura with yellow-grey bloom. Wings grey, with faint shading along the anterior margin and along the transverse veins; squammae pale grey with white bloom and having a pale-yellow outer edge and a brown inner edge; halteres yellow-rust color, limbs brown. Abdomen blackish-brown, shiny, with light grey bloom, which is denser and ligher colored along the anterior edges of the tergite. Lateral margins of ninth tergite reddish-brown and covered with grey bloom in male. Body length 5.5-6.8 mm.

This species is widely distributed in Europe and throughout the European parts of USSR; it occurs in Western Siberia and North America.

12. MIMOMERIANIA, GEN. NOV.

Frons of male slightly narrower than eyes (11:12, 17:19); ventral edge of face hardly projects forwards at all (Fig. 2, 4). Genae wider than third antennal segments and more than twice as wide as the eyes; height of subgenae approximately one third the vertical diameter of the eyes; occiput evenly convex. Antennae relatively small, third antennal segment 1.5 times as long as second; arista thickened over its proximal two thirds, barely longer than third antennal segment. Genae with scanty, short hairs; subgenae with a few hairs; eyes with a dense covering of long hairs. Occiput with one or two rows of black setiform hairs behind the post-ocular cilia; external setae of vertex and ocular setae large. Proboscis short, mentum almost as long as third antennal segment. Pro-thorax with setiform hairs along its edge. Acrostical and dorso-central setae 3+3; intra-alary 1, large; supra-alary 2; pre-alary barely longer than presutural; post-alary 2, sternopleural 2+1; all the aforementioned are long and stout; apical setae of scutellum very slender, intersecting, half as long as the very elongate, stout pre-apical setae; lateral setae considerably slenderer than the pre-apical, basal setae large, one pair of discal setae present. Costal spine absent from wing; R_5 open; bend of vein m obtuse-angled, without process; r_{4+5} with two setules at the base. Claws and pulvilli longer than fifth tarsal joint. Abdomen conical, no broader than thorax, sternites 2-4 hardly visible; sternite 5 divided by a longitudinal cleft into two narrow lobes, the internal margins of which project from under the edge of tergite 5 as narrow strips. Tergite 6 completely hidden by fifth tergite; the sclerite formed from tergites 7+8 is small and provided with a few short hairs. Lateral outgrowths of tergite 9 not isolated from the tergite itself, narrow, oval. Cerci narrow, pointed like a beak at their apices, convex proximally and bearing shallow keels; hairs are present dorsally on the cerci. Coxites long (Fig. 5, 2) and slightly inflated at the base, distal ends rounded, without teeth.

In the light of recent developments in the taxonomy of the gamily Larvaevoridae (Mesnil, van Embden), the

above genus should be regarded as belonging to the Subtribe Masicerina on the basis of its long pre-alary setae, the presence of hairs on the prothorax and the rounded thoracic squammae. In Part I of the present review the genus Mimomeriania was referred to the subtribe Ernestiina and is therefore included here along with the other genera of this group; it has one species—M. elongatula sp. nov.

1. Mimomeriania elongatula, sp. nov.

Male. Head blackish-brown, median area, lower ends of vibrissal keels brownish-red, frontal strip chestnut brown. Genae and subgenae with light grey bloom, occiput and face with dark grey bloom. Frontal strip almost parallel-sided. Palps yellow. Two basal antennal segments rust-yellow; third segment brown with a reddish tinge on its inner surface and at the base. Hairs on genae and subgenae brown. Occiput with yellowish grey hairs. Thorax brownish-black with three dark colored, broad, longitudinal stripes, separated by narrow intervals of grey bloom, except for ptero- and hypo-pleura, which have no bloom. Scutellum rust-brown, dark brown at its base.

Wings yellowish, squammae white, halteres yellow. Limbs blackish-brown, trochanters and apical parts of femora, chestnut brown. Abdomen blackish-brown, with dense whitish-grey bloom; there is a brownish, oval patch in the middle of tergite 3; tergite 4 with two indistinct brownish markings to each side of the middle. Lateral processes of tergite 9 brownish-red, glossy. The other characteristics of this species are given in the generic diagnosis.

Body length 7.5 mm.

Female not known.

This description is based on two males (holotype and allotype), collected by A.A. Shtakel'berg in Ussuri Land—Maikhe near Shkotov, June 5th 1927.

LITERATURE CITED

L.P. Mesnil, "Nouveaux Tachinaires d'Orient," Mem. Soc. Entom. Belgique 29, 1-80 (1957).

ERRATA

Vol. 38, No. 3, 1959

On page 608, the captions to the figures must be interchanged to read as follows:

Fig. 3. Culicoides turkmenicus.

Fig. 4. Culicoides tauricus.

RUSSIAN JOURNALS FREQUENTLY CITED
[Biological Sciences]

Abbreviation*	Journal*	Translation
Agrobiol.	Agrobiologiya	Agrobiology
Akusherstvo i Ginekol.	Akusherstvo i Ginekologiya	Obstetrics and Gynecology
Antibiotiki	Antibiotiki	Antibiotics
Aptechnoe Delo	Aptechnoe Delo	Pharmaceutical Transactions
Arkh. Anat. Gistol. i Émbriol.	Arkhiv Anatomii Gistologii i Émbriologii	Archives of Antomy, Histology, and Embryology
Arkh. Biol. Nauk SSSR	Arkhiv Biologicheskikh Nauk SSSR	Archives of Biological Science USSR
Arkh. Patol.	Arkhiv Patologii	Archives of Pathology
Biofizika	Biofizika	Biophysics
Biokhimiya	Biokhimiya	Biochemistry
Biokhim. Plodov i Ovoshchei	Biokhimiya Plodov i Ovoshchei	Biochemistry of Fruits and Vegetables
Bot. Zhur.	Botanicheskii Zhurnal	Journal of Botany
Byull. Éksptl. Biol. i Med.	Byulleten Éksperimentalnoi Biologii i Meditsiny	Bulletin of Experimental Biology and Medicine
Byull. Moskov. Obshchestva Ispytatelei Prirody, Otdel Biol.	Byulleten Moskovskogo Obshchestva Ispytatelei Prirody, Otdel Biologicheskii	Bulletin of the Moscow Naturalists Society, Division of Biology
Doklady Akad. Nauk SSSR	Doklady Akademii Nauk SSSR	Proceedings of the Academy of Sciences USSR
Éksptl. Khirurg.	Éksperimentalnaya Khirurgiya	Experimental Surgery
Farmakol. i Toksikol.	Farmakologiya i Toksikologiya	Pharmacology and Toxicology
Farmatsiya	Farmatsiya	Pharmacy
Fiziol. Rastenii	Fiziologiya Rastenii	Plant Physiology
Fiziol. Zhur. SSSR	Fiziologicheskii Zhurnal SSSR im. I. M. Sechenova	I. M. Sechenov Physiology Journal USSR
Gigiena i Sanit.	Gigiena i Sanitariya	Hygiene and Sanitation
Izvest. Akad. Nauk SSSR, Ser. Biol.	Izvestiya Akademii Nauk SSSR, Seriya Biologicheskaya	Bulletin of the Academy of Sciences USSR, Biology Series
Izvest. Tikhookeanskogo N. I. Inst. Rybnogo Khoz. i Okeanog.	Investiya Tikhookeanskogo N. I. Instituta Rybnogo Khozyaistva i Okeanografii	Bulletin of the Pacific Ocean Scientific Institute of Fisheries and Oceanography
Khirurgiya	Khirurgiya	Surgery
Klin. Med.	Klinicheskaya Meditsina	Clinical Medicine
Lab. Delo	Laboratornoe Delo (po Voprosam Meditsiny)	Laboratory Work (on Medical Problems)
Med. Parazitol.	Meditsinskaya Parazitologiya i Parazitarnye Bolezni	Medical Parasitology and Parasitic Diseases
Med. Radiol.	Meditsinskaya Radiologiya	Medical Radiology
Med. Zhur. Ukrain.	Medichnii Zhurnal Ukrainskii	Ukrainian Medical Journal
Mikrobiologiya	Mikrobiologiya	Microbiology
Mikrobiol. Zhur.	Mikrobiologichnii Zhurnal	Microbiology Journal
Nevropatol., Psikhyat. i Psikhogig.	Nevropatologiya, Psikhyatriya i Psikhogigiena	Neuropathology, Psychiatry and Psychohygiene
Ortoped., Travmatol. i Protez.	Ortopediya, Travmatologiya i Protezirovanie	Orthopedics, Traumatology and Prosthetics
Parazitol. Sbornik	Parazitologicheskii Sbornik	Parasitology Collection
Pediatriya	Pediatriya	Pediatrics
Pochvovedenie	Pochvovedenie	Soil Science
Priroda	Priroda	Nature
Problemy Éndokrinol. i Gormonoterap.	Problemy Endokrinologii i Gormonoterapii	Problems of Endocrinology and Hormone Therapy
Problemy Gematol.	Problemy Gematologii i Perelivaniya Krovi	Problems of Hematology and Blood Transfusion
Problemy Tuberk.	Problemy Tuberkuleza	Problems of Tuberculosis
Sovet. Med.	Sovetskaya Meditsina	Soviet Medicine
Sovet. Vrachebny Zhur.	Sovetskii Vrachebnyi Zhurnal	Soviet Physicians Journal
Stomatologiya	Stomatologiya	Stomatology

* BRITISH-AMERICAN TRANSLITERATION SYSTEM.

(continued)

(continued)

Abbreviation	Journal	Translation
Terap. Arkh.	Terapevticheskii Arkhiv	Therapeutic Archives
Trudy Gelmint. Lab.	Trudy Gelmintologicheskoi Laboratoriya	Transactions of the Helminthology Laboratory
Trudy Inst. Genet.	Trudy Instituta Genetiki	Transactions of the Institute of Genetics
Trudy Inst. Gidrobiol.	Trudy Instituta Gidrobiologiya	Transactions of the Institute of Hydrobiology
Trudy Inst. Mikrobiol.	Trudy Instituta Mikrobiologiya	Transactions of the Institute of Microbiology
Trudy Inst. Okean.	Trudy Instituta Okeanologiya, Akademii Nauk SSSR	Transactions of the Institute of Oceanology, Academy of Sciences, USSR
Trudy Leningrad Obshchestva Estestvoisp.	Trudy Leningrad Obshchestva Estestvoispytatelei	Transactions of the Leningrad Society of Naturalists
Trudy Vsesoyuz. Gidrobiol. Obshchestva	Trudy Vsesoyuznogo Gidrobiologicheskogo Obshchestva	Transactions of the All-Union Hydrobiological Society
Trudy Vsesoyuz. Inst. Eksptl. Med.	Trudy Vsesoyuznogo Instituta Eksperimentalnoi Meditsiny	Transactions of the All-Union Institute of Experimental Medicine
Ukrain. Biokhim. Zhur.	Ukrainskii Biokhimichnii Zhurnal	Ukrainian Biochemical Journal
Urologiya	Urologiya	Urology
Uspekhi Biokhimiya	Uspekhi Biokhimiya	Progress in Biochemistry
Uspekhi Sovremennoi Biol.	Uspekhi Sovremennoi Biologiya	Progress in Contemporary Biology
Vestnik Akad. Med. Nauk SSSR	Vestnik Akademii Meditsinskikh Nauk SSSR	Bulletin of the Academy of Medical Science USSR
Vestnik Khirurg. im. Grekova	Vestnik Khirurgii imeni Grekova	Grekov Bulletin of Surgery
Vestnik Leningrad. Univ. Ser. Biol.	Vestnik Leningradskogo Universiteta, Seriya Biologii	Journal of the Leningrad Univ., Biology Series
Vestnik Moskov. Univ., Ser. Biol. i Pochvov.	Vestnik Moskovskogo Universitera, Seriya Biologii i Pochvovedeniya	Bulletin of the Moscow University, Biology and Soil Science Series
Vestnik Oftalmol.	Vestnik Oftalmologii	Bulletin of Ophthalmology
Vestnik Oto-rino-laringol.	Vestnik Oto-rino-laringologiya	Bulletin of Otorhinolaryngology
Vestnik Rentgenol. i Radiol.	Vestnik Rentgenologii i Radiologii	Bulletin of Roentgenology and Radiology
Vestnik Venerol. i Dermatol.	Vestnik Venerologii i Dermatologii	Bulletin of Venereology and Dermatology
Veterinariya	Veterinariya	Veterinary Science
Vinodelie i Vinogradarstvo	Vinodelie i Vinogradarstvo SSSR	Wine-Making and Viticulture
Voprosy Klin.	Voprosy Klinicheskie	Clinical Problems
Voprosy Med. Khim.	Voprosy Meditsinskoi Khimii	Problems of Medical Chemistry
Voprosy Med. Virusol.	Voprosy Meditsinskoi Virusologii	Problems of Medical Virology
Voprosy Neirokhirurg.	Voprosy Neirokhirugii	Problems of Neurosurgery
Voprosy Onkol.	Voprosy Onkologii	Problems of Oncology
Voprosy Pitaniya	Voprosy Pitaniya	Problems of Nutrition
Voprosy Psikhologii	Voprosy Psikhologii	Problems of Psychology
Voprosy Virusologii	Voprosy Virusologii	Problems of Virology
Vrachebnoe Delo	Vrachebnoe Delo	Medical Profession
Zav. Lab.	Zavodskaya Laboratoriya	Factory Laboratory
Zhur. Mikrobiol., Epidemiol. i Immunobiol.	Zhurnal Mikrobiologii, Epidemiologii i Immunobiologii	Journal of Microbiology, Epidemiology, and Immunobiology
Zhur. Nevropatol. i Psikhiat.	Zhurnal Nevropatologii i Psikhiatrii imeni S. S. Korsakov	S. S. Korsakov Journal of Neuropathology and Psychiatry
Zhur. Obshchei Biol.	Zhurnal Obshchei Biologiya	Journal of General Biology
Zhur. Vysshei Nerv. Deyatel.	Zhurnal Vysshei Nervnoi Deyatelnosti imeni I. P. Pavlova	I. P. Pavlov Journal of Higher Nervous Activity
Zool. Zhur.	Zoologicheskii Zhurnal	Journal of Zoology

ABBREVIATIONS MOST FREQUENTLY ENCOUNTERED IN RUSSIAN BIO-SCIENCES LITERATURE

Abbreviation (Transliterated)	Significance
AMN SSSR	Academy of Medical Sciences, USSR
AN SSSR	Academy of Sciences, USSR
BIN	Biological Institute, Botanical Institute
FTI	Institute of Physiotherapy
GONTI	State United Sci-Tech Press
GOST	All Union State Standard
GRRRI	State Roentgenology, Radiology, and Cancer Institute
GTTI	State Technical and Theoretical Literature Press
GU	State University
I Kh N	Scientific Research Institute of Surgical Neuropathology
IL (IIL)	Foreign Literature Press
IONKh	Inst. Gen. and Inorganic Chemistry (N. S. Kurnakov)
IP	Soil Science Inst. (Acad. Sci. USSR)
ISN (Izd. Sov. Nauk)	Soviet Science Press
Izd.	Press
LEM	Laboratory for experimental morphogenesis
LENDVI	Leningrad Inst. of Dermatology and Venereology
LEO	Laboratory of Experimental Zoology
LIKhT	Leningrad Surgical Institute for Tuberculosis and Bone and Joint Diseases
LIPZ	Leningrad Inst. for Study of Occupational Diseases
LIPK	Leningrad Blood Transfusion Institute
Medgiz	State Medical Literature Press
MOPISh	Moscow Society of Apiculture and Sericulture
MVI	Moscow Veterinary Institute
MZdrav	Ministry of Health
MZI	Moscow Zootechnical Institute
LOKhO	Leningrad Society of Orthopedic Surgeons
NIIZ	Scientific Research Institute of Zoology
NINKhI	Scientific Research Institute of Neurosurgery
NIU	Scientific Institute for Fertilizers
NIUIF	Scientific Research Institute of Fertilizers and Insecticides
NIVI	Veterinary Scientific Research Institute
ONTI	United Sci. Tech. Press
OTI	Division of Technical Information
RBO	Russian Botanical Society
ROP	Russian Society of Pathologists
SANIIRI	Central Asia Scientific Research Institute of Irrigation
SANIISh	Central Asia Scientific Research Institute of Sericulture
TsNII	All-Union Central Scientific Research Institute
TsNTL	Central Scientific and Technical Laboratory
VASKhNIL	All-Union Academy of Agricultural Sciences
VIG	All-Union Institute of Helminthology
VIEM	All-Union Institute of Experimental Medicine
VIR	All-Union Institute of Plant Cultivation
VIUAA	All-Union Institute of Fertilizers, Soil Science, and Agricultural Engineering
VIZR	All-Union Institute of Medical and Pharmaceutical Herbs
VNIRO	All-Union Scientific Institute of Fishing and Oceanography
ZIN	Zoological Inst. (Acad. Sci. USSR)

Note: Abbreviations not on this list and not explained in the translation have been transliterated, no further information about their significance being available to us. - Publisher.